ORTHOPAEDIC SECTION ABSTRACTS: 
POSTER PRESENTATIONS 
OPO1-OPO300

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OPO1

A COMPARISON OF ABDOMINAL MUSCLE THICKNESS IN UNLOADED AND LOADED POSITIONS IN NORMAL ADULTS

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PURPOSE/HYPOTHESIS: Transversus abdominis (TA) activation has been established with the abdominal draw-in maneuver (ADM), but few studies have examined abdominal muscle thickness in functional positions, such as standing and with exercise. This study compared abdominal muscle thickness at rest and with muscle contraction in unloaded (hook-lying) and loaded (standing) positions using common clinical exercises.

NUMBER OF SUBJECTS: Thirty-six normal participants (29 female; mean ± SD age, 25.0 ± 2.59 years; BMI, 23.65 ± 2.75 kg/m²).

MATERIALS/METHODS: Ultrasound images of the rectus abdominis above the arcuate line (RAA), rectus abdominis below the arcuate line (RAB), external oblique (EO), internal oblique (IO), and TA were captured under resting (ADHL) and loaded (hook-lying) conditions.

RESULTS: A comparison of muscles at rest in the 2 positions yielded significant differences for RAB (P < .01), IO (P < .001), and TA (P < .001). Significance was found in comparing rest to ADM in hook-lying for RAA (P < .001), EO (P < .02), IO (P < .001), and TA (P < .001). A significant difference between rest and a low row maneuver in standing was found for RAA (P < .001), RAB (P < .001), and IO (P < .001). Results of the paired t-tests comparing ADM to the low row maneuver showed a significant difference in thickness for all muscles (RAA, P < .001; RAB, P < .001; EO, P = .001; IO, P < .001; and TA, P = .02). A significant main effect for exercise (F(1,34) = 7.01, P = .01) and position (F(1,34) = 7.94, P < .01), as well as a significant interaction (F(1,34) = 6.90, P < .01), was found for RAA. A significant main effect for position (F(1,34) = 8.61, P < .01) was found for RAB. A significant main effect for exercise (F(1,34) = 9.79, P < .01) and position (F(1,34) = 6.92, P = .01) was found for IO.

CONCLUSIONS: All muscles appeared to be thicker at rest in standing how-
COMBINED SECTIONS MEETING

OUTCOMES: Following 4 weeks of the prescribed exercise, she demonstrated a decrease in symptoms with improving scores on the Neck Disability Index, Dizziness Handicap Inventory, and Headache Disability Index. The patient increased her heart rate before symptom onset during BCTT retest, showing an increase in activity tolerance. Subjectively, the patient reported she had doubled her hours at work and was exercising independently again.

DISCUSSION: Initiating an aerobic exercise plan based on results from the BCTT allowed this patient to improve her PCS symptoms which had limited her ability to return to full time work. This is consistent with the findings of Baker (2012), Leddy (2016), and Graboski (2016) who found that using a protocol of subsymptom aerobic exercise would increase activity tolerance and decrease PCS symptoms for athletes. This case study shows that those principles apply to nonathletes as well. Sub-symptom aerobic exercise training is an emerging and important tool for helping PCS patients improve their levels of function. Potential limitations of this case study include: the patient had therapy for 2.5 months prior to the start of the aerobic exercise, the previous and ongoing therapy likely contributed to the patient’s improvement, there is no control to determine the amount of impact the BCTT had on the positive outcomes, the aerobic exercise protocol is not appropriate for all patients with PCS, and other considerations for PCS should be evaluated and treated.


OP04

PATIENTS’ THOUGHTS AND PERSPECTIVES ON PAIN IN AN OUTPATIENT PHYSICAL THERAPY PRACTICE: A DESCRIPTIVE STUDY

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PURPOSE/HYPOTHESIS: Musculoskeletal pain is the most frequent complaint for which people seek medical treatment. Pain is a powerful motivating factor that is subjective and a universal human experience that can guide treatment-seeking behaviors in patients. There is a complexity to pain that combines multiple pain generators and amplifiers including fear, avoidance, anxiety, stress, beliefs, and depression. The purpose of this descriptive survey study was to analyze patients’ beliefs, expectations, and misconceptions regarding pain beliefs.

NUMBER OF SUBJECTS: Fifty-four.

MATERIALS/METHODS: A mixed methods approach utilizing a convenience sample of 54 patients with a chief complaint of pain completed a 16-item survey prior to physical therapy consultation. The survey included demographic information. The survey incorporated a 11-point numeric pain rating scale, and several open and close-ended questions arising from previously validated outcome measures such as the Fear-Avoidance Beliefs Questionnaire (FABQ), Pain Catastrophizing Scale (PCS), Pain Beliefs Questionnaire (PBQ), and Pain Neurophysiology Questionnaire. Data were collected from March 2015 to September 2015. The qualitative data were then synthesized using a thematic analysis.
**RESULTS:** Four main themes emerged from the data: (1) chronicity (63% reported pain lasting 6 months or more); (2) emotional lability (27.8% responded emotionally when they experienced pain); (3) fear avoidance (56% reported that they thought about pain “often” or “all of the time”); and (4) pain catastrophization (64% expressed their belief that having higher pain intensity is proportional to the amount of tissue damage).

**CONCLUSIONS:** The results of this study are consistent with those discussed in previous research utilizing a biopsychosocial model. This model integrates the interaction between the environment, psychological, biological, and social components of pain. The model also focuses on the lack of patients’ knowledge regarding pain and maladaptive beliefs, which lead to functional disability. The results suggest a need for management through a biopsychosocial approach given the flaws and gaps within the current biomedical model which have not grasped the importance of all-encompassing patient care. Further research is indicated regarding the validity of 16-item survey created for this study.

**CLINICAL RELEVANCE:** This descriptive study explored the beliefs, expectations, and perceptions about patients’ pain prior to physical therapy consultation. From the open-ended questions, several themes emerged that may aid the clinician in understanding how patients perceive their pain and also how it affects them. These same themes may be used to further aid in the development and improvement of psychosocially based outcome measures and screening tools. This study also adds the importance of an early start to biopsychosocial management to improve function and decrease fear to reduce health care cost.

**OP05**

**PROGNOSTIC FACTORS FOR THE POOR PAIN AND UPPER EXTREMITY FUNCTIONAL OUTCOMES AFTER DISTAL RADIUS FRACTURE: A SYSTEMATIC REVIEW**

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**PURPOSE/HYPOTHESIS:** As many as 20% to 30% individuals report poor pain and upper extremity functions (UEF) even 1 year after the Distal Radius Fracture (DRF). Primary studies have shown that being 65 years or older, female sex, high school education or less, high velocity injury, comminution of fracture, and postinjury radial shortening are associated with poor recovery in pain and functions after DRF. However, a systematic review of the existing literature to examine the overall associations between these factors and the recovery after DRF is yet to be conducted. This study searched, located, and appraised the primary studies that examined the prognosis of pain and UEF after DRF.

**NUMBER OF SUBJECTS:** Not applicable.

**MATERIALS/METHODS:** Four databases (PubMed, CINAHL, MEDLINE, Thesis and Dissertation) were searched in November 2016 to locate studies that examined the prognostic indicators of poor pain and UEF at up to 1 year after DRF. Studies that assessed longitudinal associations between baseline demographic, health, or injury related variables and pain with UEF after DRF were included. Two student physical therapists (SPT) appraised the quality of the studies included in the review using a 25-item standardized checklist. Statistics such as relative risk/odds ratio (RR/OR) or beta values indicating the longitudinal associations between baseline variables and poor pain and functional status were extracted and presented.

**RESULTS:** Search process yielded a total of 1107 articles, of which 22 were deemed eligible and included. Nineteen studies scored greater than 70% on the quality appraisal, exceeding the benchmark that indicates good quality. The unweighted kappa between the 2 SPT raters was 76% which indicates substantial agreement in assessing quality of the studies. Being older than 65 years of age was significantly associated with poor UEF at 6 months (beta, -0.28; P = .003) and 1 year (P = .003) after DRF. Being female was significantly associated with the development of Complex Regional Pain Syndrome (CRPS) (OR = 5.77, P = .0167; OR = 2.18, P<.053). High school education or less was found to be significantly associated with poor pain and UEF at 1 year (beta, -6.1; P = .0072; beta, 1.37; P = .0178). Last, high baseline pain was associated with the development of CRPS (OR = 3.3, P<.05) and chronic wrist pain at 1 year (OR = 7.8, P<.001).

**CONCLUSIONS:** Being older than 65 years of age, of female sex, and having high school education or less are associated with poor outcomes after DRF. Individuals who have a combination of 2 or more of these risk factors should be engaged in rehabilitation that is focused on pain and functional training to optimize the outcomes after DRF.

**CLINICAL RELEVANCE:** Clinical practice guidelines for DRF do not address prognosis-based management despite comprehensive evidence suggesting that individuals with certain traits are at greater risk of poor pain and UEF after DRF. This review will serve as a summary of comprehensive evidence and will assist physical therapists in identifying individuals at risk of poor outcomes after DRF and intervene to mitigate the risks.

**OP06**

**IMMEDIATE EFFECTS OF CERVICAL SPINE MANIPULATION ON GAIT PARAMETERS IN INDIVIDUALS WITH NECK PAIN**

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**PURPOSE/HYPOTHESIS:** To investigate for any change in gait parameters for individuals with neck pain (NP) walking with different functional neck conditions immediately after receiving cervical thrust joint manipulation (TJM) versus a sham intervention, and also to investigate the effect of Global Rating of Change (GROC) scores on gait parameters. The hypothesis was that cervical TJM would have an immediate effect on gait velocity and symmetry during walking with neck during 3 conditions (neutral, flexion/extension and rotation) for individuals with NP.

**NUMBER OF SUBJECTS:** Convenience sample of 40 individuals (30 female; mean ± SD age, 24.5 ± 6.78 years) with NP. To qualify, subjects had to score greater than 2 on numeric pain-rating scale (NPRS) and have no contraindications or precautions for cervical TJM.

**MATERIALS/METHODS:** Subjects walked on a Zeno Walkway under the following conditions: (1) head in neutral (2) head rotating from side-to-side, and (3) head nodding up and down. After completing 30 practice trials (10 in each condition), trial 1 was recorded for each of the 3 conditions in a randomized order. After a 5-minute rest period, preintervention trial 2 was conducted for each condition in same order as trial 1. Subjects then received 1 of 2 randomly assigned interventions: cervical spine TJM or active cervical rotation. Immediately after intervention, the subject returned to the Zeno Walkway for postintervention trial with each of the 3 conditions, in the same order as previous trials.

**RESULTS:** Gait velocity and symmetry were not found to be significantly different for subjects who received cervical TJM compared to sham intervention. There was also no significant effect for positive versus no change or negative response in subjective pain ratings (GROC) in regards to differences in gait. However, there was a significant interaction between time and treatment on velocity (P = .008), step length (P<.001), and stride length (P = .009) when head was sustained in neutral for the group that received cervical TJM treatment. There was also a significant change in NPRS with an average decrease of 1.25 (P = .003) and significant change in GROC score with an average increase of 2.85 (P = .001) for the group that received cervical TJM.

**CONCLUSIONS:** These findings are not consistent with the hypothesis that gait velocity and symmetry are immediately affected by cervical TJM in people with NP. The significant interaction with the neck in neutral implies that there may be a small improvement in gait velocity for subjects who received cervical TJM when compared to subjects who received sham treatment. Results regarding pain reduction are consistent with previous studies conducted on cervical TJM.
OP07

THE RELATIONSHIP BETWEEN DIABETES AND KNEE PAIN SEVERITY, UNILATERAL OR BILATERAL KNEE PAIN: DATA FROM THE OSTEOARTHRITIS INITIATIVES

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PURPOSE/HYPOTHESIS: Knee osteoarthritis (OA) and diabetes (DM) are co-existing diseases with a potentially greater negative impact on pain. DM may affect pain severity and locations. Therefore, the first aim was to compare pain severity over the last 30 days in people with knee OA without DM to people with knee OA and DM. The second aim was to explore the association between DM and knee pain locations such as unilateral versus bilateral knee pain. We hypothesized that people with knee OA and DM would have higher pain severity, and bilateral knee pain would be associated with knee OA and DM.

NUMBER OF SUBJECTS: The sample included 4796 individuals who had enrolled in the Osteoarthritis Initiative, which is an ongoing longitudinal study of individuals with knee OA. Of these participants, 2541 provided data regarding knee pain with either unilateral or bilateral knee pain, with a subgroup of 323 participants having DM.

MATERIALS/METHODS: This is a cross sectional analysis of the 96-month follow-up visit. Pain severity was measured using a numeric rating scale with 0 (no pain) to 10 (severe pain) over the last 30 days for both right and left knees. Self-reported bilateral knee pain was further assessed and repeated for right and left knees using the following question: “Now think about the past 30 days. During the past 30 days, have you had any pain, aching or stiffness in your right/left knee?” If the participant answered yes to both questions (right and left knees), they were categorized as having bilateral knee pain. Self-reported DM was included as a risk factor. Analysis of covariance (ANCOVA) was used to analyze differences in pain severity between people with and without DM. A binary logistic regression was utilized for unilateral versus bilateral knee pain, with adjustments for age, BMI, and depression.

RESULTS: Results from the ANCOVA showed that people who had DM and right or left knee pain reported significantly higher average pain severity in the last 30 days compared to people who have knee OA without DM (right knee pain, 4.29 ± 2.81 versus 3.26 ± 2.60; left knee pain, 3.95 ± 3.00 versus 3.10 ± 2.67; P<.05, respectively). For bilateral knee pain, unadjusted analyses showed that DM was significantly associated with bilateral knee pain (odds ratio [OR] = 1.37; 95% confidence interval [CI]: 1.07, 1.77; P = .014). In the adjusted analyses, DM was not significantly associated with bilateral knee pain.

CONCLUSIONS: People with DM and knee OA had higher pain severity when compared to people with knee OA without DM. Although unadjusted analyses indicated an association between DM and bilateral knee pain in people with knee OA, our hypothesis was not supported by the adjusted analysis. The relationship between DM, pain and other variables (age, BMI and depression) requires further studies.

CLINICAL RELEVANCE: Clinicians ask about knee pain severity and locations (unilateral versus bilateral) for further diagnostics or treatment approaches. Clinicians should also consider inquiring about diabetes during knee pain assessment for better health care.
NUMBER OF SUBJECTS: Twenty quantitative studies from peer-reviewed journals were reviewed. All studies included MT as a treatment intervention and used at least 1 pain outcome measure pertaining to PLP. Studies not available as full text or not accessible in English were excluded.

MATERIALS/METHODS: CINAHL, Cochrane Library, Google Scholar, and PubMed were searched between January 2016 and February 2017 for “phantom limb pain” and/or “mirror therapy.” Systematic reviews, randomized control trials, controlled pilot studies, and controlled and uncontrolled case series were reviewed. A compendium was established of MT treatment intervention components utilized, frequency and settings of practice, outcome measures and adverse reactions, with cross-study efficacy comparisons to determine viable MT elements. When published studies contained insufficient detail on MT intervention, principle investigators were contacted by email with requests for additional information on treatment details and dosing.

RESULTS: Among the 20 studies reviewed, MT was used as the primary treatment for PLP. MT was frequently preceded by laterality training and graded motor imagery. Effective treatment components utilized during MT sessions included multifaceted somatosensory stimulation, distal movements, and functional activities. MT was found effective whether via direct therapist supervision in-clinic or with therapist-designed activities conducted as home programs. A comprehensive clinical practice guideline was synthesized for presentation, based on positive outcome measures regarding pain and clinical usefulness.

CONCLUSIONS: Current literature shows that mirror therapy can significantly reduce pain and improve pain-related function in patients with phantom limb pain. Treatment elements found to be effective in controlled studies have afforded synthesis of a comprehensive, evidence-based clinical practice guideline for implementation of MT by therapists treating PLP.

CLINICAL RELEVANCE: Mirror therapy efficacy literature has established its viability as a treatment for phantom limb pain, however, lack of sufficient published detail regarding components and parameters of treatment left therapists at a loss as to how to most effectively implement MT with patients. This clinical practice guideline helps therapists easily implement mirror therapy; rendering a more thorough and effective plan of care for patients with PLP.

OP010

EFFECTS OF LUMBOPELVIC MANIPULATION ON NEUROMUSCULAR ACTIVITY OF BACK AND HIP MUSCLES IN ADULTS WITH CHRONIC BACK PAIN

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PURPOSE/HYPOTHESIS: Patients with chronic low back pain (CLBP) have been shown to have increased fatigability levels of hip and low back muscles as measured by the surface electromyographic (sEMG) median frequency (MF). In addition, literature suggests that lumbopevic manipulation could be an effective intervention for reducing CLBP. However, the effects of lumbopevic manipulation on lumbar or hip muscle fatigability have not been studied previously. The purposes of the study were to examine the immediate and short-term effects of a single lumbopevic manipulation on the muscle fatigability level of the lumbar multifidus (MULT), gluteus maximus (GMAX) and gluteus medius (GMED) muscles in addition to the pain level as compared to a placebo intervention in patients with CLBP.

NUMBER OF SUBJECTS: Thirty-one participants with CLBP, 30.2 ± 10.1 years of age, completed the immediate effect part of the study, and 27 participants, 29.9 ± 8.1 years of age, completed the short-term effect part of the study.

MATERIALS/METHODS: Three sEMG electrodes were placed on the painful side of the MULT, GMAX and GMED muscles. For the immediate effect part of the study, sEMG was collected during the modified Biering-Sorensen test 5 times: before the intervention, and immediately, 15 minutes, 30 minutes, and 45 min after the intervention. After the baseline sEMG recording, each participant was randomized into 1 of 2 intervention groups: manipulation and placebo. Participants in the manipulation group received a high-velocity low-amplitude lumbopevic manipulation. Participants in the placebo group were set up in a position for the lumbopevic manipulation, but did not receive a thrust. For the short-term effects part of the study, sEMG of the 3 muscles were recorded during the modified Biering-Sorensen test 3 days and 1 week after the intervention. In addition, pain level was collected at all 7 time points.

RESULTS: There was no significant difference in the fatigability level of the 3 muscles between groups before and 4 time points after the intervention. However, the manipulation group had a significant reduction in pain as compared to the placebo group between 15 and 30 minutes after the intervention \( (P = .032) \). In addition, there was no significant difference between groups on fatigability level of the 3 muscles 3 days and 1 week after intervention. Both groups had significant pain reduction 3 days \( (P = .019) \) and 1 week \( (P<.001) \) after the intervention.

CONCLUSIONS: Although manual intervention had a positive effect on pain reduction, it did not alter the fatigability level of the back and hip muscles.

CLINICAL RELEVANCE: Manual intervention can be a useful treatment approach to decrease pain in patients with CLBP. However, clinicians may consider other treatment options when the goal is to improve fatigability of the back and hip muscles for this patient population.

OP011

THE ROLE OF PHYSICAL THERAPY IN ADDRESSING THE OPIOID EPIDEMIC:

GETTING TO THE SOURCE OF THE PAIN

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BACKGROUND: The purpose of this study is to present information on the opioid epidemic as it relates to chronic pain, introduce literature regarding the potential benefits of physical therapy/exercise on the clinical management of chronic pain, and propose physical therapy as a first-line treatment for patients with opioid dependency.

MATERIALS/METHODS: The databases PubMed, CINAHL, and Cochrane Library were used to identify studies to include in this review. Our search parameters included studies in English that were published between 2008 and 2016, which had investigated either chronic pain and opioids, physical therapy/exercise and chronic pain, or physical therapy/exercise and substance abuse disorders. Search terms included “exercise,” “physical therapy,” “substance abuse disorder,” “chronic pain,” and “opioids.” Randomized controlled trials (RCTs), systematic reviews, and meta-analyses were included in this paper.

RESULTS: One thousand three hundred fifty studies were identified by the literature search, and 1303 were rejected due to irrelevance based on our specified search parameters. We evaluated 47 studies in detail, of which 31 did not meet our criteria. Consequently, we included 16 studies in this review: 10 RCTs, 4 systematic reviews, and 2 meta-analyses. The evidence suggests opioids are commonly prescribed for the management of chronic pain. However, long-term opioid use does not alleviate the symptoms of chronic pain and may lead to opioid addiction. Physical therapy consisting of manual therapy and aerobic exercise has been proven to reduce chronic pain. Moreover, specific exercise programs and client education have positive effects in patients suffering from substance at various stages of recovery.

DISCUSSION: We conclude that physical therapy may be valuable in addressing the opioid epidemic. Not only does it contribute to addiction recovery, but it is also a nonpharmacological option for the effective management of chronic pain, commonly the problem for which opioids were originally prescribed. Other (funding, registration): No funding was provided for this review.
OP012
HIP ROTATION RANGE OF MOTION IN NATIONAL BASKETBALL ASSOCIATION PLAYERS: ESTABLISHING A NORMATIVE DATABASE
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PURPOSE/HYPOTHESIS: Hip mobility in basketball athletes influences performance and risk of lower quarter injury. There is a challenge when setting rehabilitative range of motion (ROM) goals with National Basketball Association (NBA) players because of the lack of a normative data base and little understanding about dominant and nondominant differences. The American Academy of Orthopaedic Surgeons report an average internal and external hip ROM of 45°. The purpose of our study was to determine mean values for hip ROM in NBA players and determine if there were significant differences between dominant and nondominant limbs. We hypothesized that NBA players would demonstrate less hip mobility than what is reported in the general population and that they would have asymmetrical hip motion as the consequence of favoring their dominant limbs when performing basketball activities.

NUMBER OF SUBJECTS: Sixty-three.

MATERIALS/METHODS: Measurements were completed as part of preseason mobility screening prior to the 2015-16 and 2016-17 NBA seasons. Dominant (DOM) and nondominant (ND) hip internal and external rotation (IR and ER) ROM measures were taken on all 63 participants. A board certified orthopaedic clinical specialist performed all ROM measurements using an inclinometer. Measurements were taken with subjects in prone, with the knee flexed to 90°. Total hip rotational ROM was calculated as the sum of IR ROM and ER ROM. Dominant and nondominant total hip rotational ROM was compared for each subject.

RESULTS: Data from all 63 basketball players were included in the statistical analysis. Descriptive statistics revealed: DOM IR, 24.53° ± 7.77°; ND IR, 23.30° ± 7.57°; DOM ER, 50.98° ± 9.06°; DOM TR, 59.81° ± 10.62°; ND TR, 57.25° ± 12.97°. A 2-tailed paired t test comparing the dominant and nondominant total hip ROM revealed a statistically significant difference, yielding a P value of 0.031 (P<.05).

CONCLUSIONS: These findings support our hypothesis that NBA players present with less hip ROM compared to text book values reported for the general population. Likewise, we found that NBA players present with asymmetrical dominant and nondominant total hip ROM and that motion is biased towards external rotation. The results demonstrate that significantly greater dominant-side hip rotation ROM is not only normal, but can be expected in many NBA basketball players. Finally, the descriptive statistics establish normative total hip rotational ROM values for professional basketball players.

CLINICAL RELEVANCE: Elite athletes strive to minimize injury risk and maximize performance. Hip total rotation ROM symmetry in high performance professional basketball players may not be the goal to allow them to play their sport to the best of their ability. Likewise, increasing hip range of motion in NBA players to match that of the normal population may have negative implications in their functional performance and/or health. This study gives a foundation for future studies investigating normal values for total range of motion for higher level performance athletes.

OP013
APPROPRIATE MANAGEMENT OF A PATIENT WITH UNDIAGNOSED MULTIPLE SCLEROSIS PRESENTING WITH KNEE PAIN
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BACKGROUND AND PURPOSE: Multiple sclerosis is a disease of the nervous system that affects the brain and spinal cord. By damaging myelin sheaths, neurological signals are slowed throughout the body, creating a myriad of dysfunctions. Symptoms include muscle weakness, visual disturbances, coordination/balance deficits, numbness and tingling, and cognitive impairments. The purpose of this presentation is to highlight a clinical case of a patient presenting to an outpatient orthopaedic clinic with an undiagnosed neurological disease, which upon further diagnostic testing, was found to be multiple sclerosis.

CASE DESCRIPTION: A 33-year-old woman presented to the physical therapy clinic with a referral for 10-month history of right knee pain/instability, which began following a car accident. Patient stated that her knee “bent backward.” MRI revealed a medial meniscus tear and lateral partial-thickness cartilage loss of the lateral patellar facet. During evaluation, knee pain was moderate and rated at 5/10. Patient’s primary complaint related to having to hold onto walls due to a lack of balance. Patient demonstrated several obvious gait deviations, poor squat form, and inability to perform single limb balance on right leg without immediate loss of balance. Patient also unable to perform a standing myotomal screen due to poor balance. Strength of right and left legs rated globally weak (2+/5 bilaterally). Special testing revealed a positive pivot shift, straight leg raise, and slump on right leg, revealing knee instability and adverse neural tension. Due to poor balance and gait deviations, reflexes were performed, which revealed a hyperactive patellar reflex bilaterally; while Achilles reflexes were normal. Babinski sign and clonus was also present bilaterally. The patient’s physician was contacted with the PT evaluation findings to have imaging of the head and cervical spine performed. MRI later revealed: “Multiple foci of T2 hyperintensity in bilateral cerebral and cerebellar white matter, corpus callosum, basal ganglia, and brainstem. Focal T2 hyperintensity in left side of the cervical spinal cord at C5. These changes are consistent with multiple sclerosis. None of the lesions enhance, to suggest acute or active demyelination.”

OUTCOMES: The patient was ordered to continue physical therapy, which had been focusing on lower quarter strengthening and dynamic stability/balance to that point. It was decided by the treating PT that the patient would benefit more from the skilled care of a neurologic PT specialist, and a referral was obtained for this reason. The patient attended 2 sessions of neuro PT, where AFO braces were trialed (with benefit), but the patient was lost to follow-up.

DISCUSSION: Referral back to a physician for further diagnostic workup may be warranted if a patient presentation does not line up with findings normally seen in a traditional case of orthopaedic knee pain. With the proper testing and clinical reasoning, physical therapists are well qualified to make this judgment for the greater good of their patients.


OP014
CLINICAL DECISION MAKING WITH AN UNDIAGNOSED CERVICAL SYRINX
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BACKGROUND AND PURPOSE: A syrinx is a cerebrospinal fluid filled cavity that forms within the spinal cord (syringomyelia) or brain stem (syringobul-
A 43-year-old male construction worker injured his neck during a motor vehicle accident 2 and a half months prior to evaluation. Patient was taken to the emergency room and released after radiographs were negative. Patient returned to work with worsening neck pain, numbness and tingling, along with progressive weakness of the right arm. Patient exhibited limited cervical spine and right shoulder range of motion during evaluation. Muscle atrophy and decreased strength of the right upper extremity (UE) was noted with significant deficits of the right finger flexors and poor activation of the wrist flexors. Patient demonstrated gross paresthesia of the right UE from the forearm to the fingers, abnormal pain sensitivity with light touch, palpable coldness of the right hand, and impaired proprioception of second to fourth digits. Impaired right UE deep tendon reflexes were documented with absent triceps and biceps reflex as well as increased right brachioradialis reflex with a significant jump response. Cranial nerve screen resulted in nystagmus of bilateral eyes and impaired smooth pursuit. Positive Special Tests: compression, distraction, Spurling’s, upper limb tension tests, and Tinel’s. Patient’s activity limitations were gripping/grasping using the right hand, resulting in an inability to properly lift and carry equipment or using hand tools.

OUTCOMES: Immediately following the evaluation, the supervising physical therapist collaborated with the medical doctor and the cervical spine Magnetic Resonance Image (MRI) order was updated to an urgent referral. The MRI results showed extensive cervical spinal cord syrinx extending the entire length of visualized cord, approximately from cranio-cervical junction to T4 measuring 2.5 mm to 3.0 mm in diameter. Physical therapy was placed on hold with patient referred to neurosurgeon. Neurosurgeon recommended additional MRI of brain, entire spine, brachial plexus/shoulder. Results of brachial plexus/shoulder MRI normal.

DISCUSSION: The process for ordering and approving a cervical spine MRI may take up to several weeks, during which time symptoms could worsen and/or inappropriate and unnecessary services be administered. Collaboration between the PT and MD is vital in setting the proper course of treatment for abnormal presentations. Physical therapists’ clinical decision making, knowledge of best practice, ability to effectively communicate and establish rapport with medical doctors is essential to ensuring optimal care.


OP015
THE EFFECTS OF THORACIC SPINE THRUST MANIPULATION ON CERVICAL JOINT POSITION ERROR
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PURPOSE/HYPOTHESIS: The purpose of this study was to assess the effects of mid-thoracic spine thrust manipulation on cervical joint position error (JPE) for cervical flexion, extension, and rotations in healthy adult subjects.

NUMBER OF SUBJECTS: Thirty-six healthy individuals (28 female, 8 male; mean ± SD age, 31.9 ± 2.2 years) voluntarily participated in this study.

MATERIALS/METHODS: Participants were seated in a chair with back and armrests with their head in a comfortable resting position so the crown of their head was 90 cm from a Tracker target on a wall in front of them. Each subject had a head strap with a Tracker laser pointer (www.track-er laser.com) attached to the head. A GoPro camera (CHDHX-401, San Mateo, CA) on a tripod was placed directly behind and above the participant’s head in order to take pictures during the process. JPE was assessed with each subject completing a total of 5 repetitions in each of the 4 directions in a randomized order. Upon completing the last trial subjects received 3 flexion-distraction thrust manipulations to the mid-thoracic spine while sitting on a plinth. Immediately following thrust manipulation JPE was reassessed. Mean absolute error, variable error, and frequency of abnormal JPE were computed for each direction.

RESULTS: For absolute error, there were no significant differences in cervical JPE between the premanipulation condition and the postmanipulation condition for flexion (P = .086), extension (P = .064), and right rotation (P = .258). A significant reduction in the absolute error for cervical JPE was found in left rotation (P = .040) between the premanipulation condition and the postmanipulation condition. For variable error, there were no significant differences between premanipulation and postmanipulation for extension (P = .544), right rotation (P = .453), and left rotation (P = .570). A significant reduction in variable error between pre and postmanipulation condition was calculated for flexion (P = .020). Analysis of frequency of subjects with mean JPE greater than 4.5° in each direction revealed postmanipulation reductions ranging from 2.3% (left rotation) to 13.9% (extension); however, none of these reductions were statistically significant.

CONCLUSIONS: Thoracic thrust manipulation appears to improve the accuracy of cervical repositioning as seen in the reduction of absolute JPE with cervical rotation postmanipulation. Additionally, thoracic thrust manipulation appears to improve the precision of cervical repositioning as seen in the reduction of variable JPE with cervical flexion postmanipulation.

CLINICAL RELEVANCE: Thoracic thrust manipulation may lead to immediate, short-term improvements in the accuracy and/or precision of cervical repositioning and may be warrant use as an adjunct to cervical proprioceptive training. Future investigations should focus on the effect of other interventions on cervical joint position error in different patient populations (i.e., patients with neck pain, whiplash, or craniofacial pain).

OP016
DYNAMIC FUNCTION IN THE SYMPTOMATIC HIP WITH FEMORAL ACETABULAR IMPINGEMENT COMPARED TO A RADIOGRAPHICALLY DOCUMENTED HEALTHY CONTROL GROUP DURING STAIR ASCENT AND DESCENT
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PURPOSE/HYPOTHESIS: Kinematic and electromyography (EMG) during walking and squatting have been reported for individuals with cam femoral acetabular impingement (FAI). However, the use of a radiographically healthy control group is not included typically. In addition, existing reports are not in agreement. Few differences in level walking have been documented. The primary aim of this study was to determine if, during stair ascent and descent, kinematics, kinetics, and electromyography of the lower extremity were different between symptomatic FAI subjects and radiographically healthy controls.

NUMBER OF SUBJECTS: Twenty.

MATERIALS/METHODS: A prospective, cross-sectional, IRB approved study enrolled a cohort of 10 healthy nonarthritic males (mean ± SD age, 25
Effects of Real-time Biofeedback Using Instrumented Insoles on Recovery after Total Knee Arthroplasty: A Pilot Study

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PURPOSE/HYPOTHESIS: To investigate the initial feasibility and efficacy of a movement pattern training program (MOVE) on the recovery of movement patterns, strength, and function following total knee arthroplasty (TKA).

NUMBER OF SUBJECTS: Eight individuals (mean ± SD age, 63.3 ± 6.5 years) scheduled to undergo TKA for end-stage osteoarthritis (OA) were enrolled.

MATERIALS/METHODS: The MOVE program is an evidence-based contemporary rehabilitation program that consists of task training, education, progressive resistive exercise, range of motion, balance and agility training. Task training is augmented with real-time biofeedback delivered via instrumented insoles (Pedoped, Novel.de) in both the clinic and home settings through an iOS device. Subjects were seen twice a week for 6 weeks and were assessed preoperatively, 6 weeks (end of intervention), and 6 months after TKA. Patient enjoyment of the insoles was measured using an 8-camera motion analysis system with embedded force plates (ratio: surgical-nonsurgical). Quadriceps strength asymmetry (QSA) ratios were assessed using an electromechanical dynamometer. Functional performance was assessed using the 5 times sit to stand test (FTSSST) and 6-minute walk (6MW) test. Descriptive statistics and paired t tests were utilized to analyze changes over time.

RESULTS: All subjects were able to use biofeedback both in clinic and at home and rated the insoles at a high level of enjoyment on the IMI (median, 6.8 out of 7). WBA during bilateral stance, over ground walking, and rising from a chair returned to baseline by the end of intervention (all, \( P < 0.05 \)) and subjects exhibited symmetrical weight-bearing by 6 months on all tasks (WBA ratio = 1.0, 0.99, 0.98, respectively). KEMA and QSA ratios recovered to baseline by the end of intervention (all, \( P < 0.05 \)) and by 6 months QSA mean performance improved. 6MW and FTSSST performance recovered to baseline levels by the end of intervention (both \( P < 0.05 \)) and by 6 months mean performance had improved beyond baseline.

CONCLUSIONS: Previous studies have found that patients consistently exhibit lower-limb movement asymmetry during dynamic tasks after TKA. However, subjects in the MOVE program demonstrated symmetrical weight-bearing on all tasks at 6 months. KEMA and QSA also improved to higher levels than typically reported. Recovery of functional performance was also enhanced with the MOVE intervention, as patients typically do not recover to baseline levels until 2 to 3 months after TKA. Further randomized controlled trials are needed to determine the effectiveness of the MOVE program on recovery after TKA as well as the long-term impact of movement asymmetry on contralateral OA progression.

CLINICAL RELEVANCE: Real-time weight-bearing biofeedback training is feasible to implement into clinical practice and may lead to improved movement symmetry and functional recovery after TKA.
CLINICAL RELEVANCE: These findings were consistent with neuromuscular factors of the hip muscles and increased knee adduction in runners with iliotibial band syndrome. This study confirms the need to further investigate hip muscle control as an influence on kinematic deviations of the knee in patients with iliotibial band syndrome. In addition, the increased deviation in knee adduction needs further investigation as a factor that affects kinematic changes during a prolonged run.

OP019
BLOOD FLOW RESTRICTION TRAINING FOR CHRONIC QUADRICEPS WEAKNESS AND ATROPHY: A CASE REPORT
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BACKGROUND AND PURPOSE: The high load and intensity of traditional strength training may not always be appropriate or beneficial for certain patient populations such as the elderly or those with orthopaedic injuries. In these cases blood flow restriction training with light resistance has been shown to be effective method of increasing strength and hypertrophy. However, what if traditional strength training is tolerated but not effective for an individual? The purpose of this case report is to describe the use of blood flow restriction training in a recreationally active male who was fully functional but continued with chronic unilateral quadriceps weakness and atrophy.

CASE DESCRIPTION: A 37-year-old man who participated in frequent physical activity and was functional for daily activities and hobbies presented with decreased quadriceps strength and atrophy 25 years post a well healed femur fracture. A 15% deficit was noted on initial evaluation during isokinetic testing along with a 2-cm difference in quadriceps girth. Light resistance, isotonic, single leg quadriceps strengthening was performed on the involved lower extremity with blood flow restriction. These exercises included straight leg raises, long arc knee extension and single leg press on the shuttle. A blood flow restriction device was used with the settings applied according to the instructions from the manufacturer. The cuff was placed as proximal as possible on the patient’s thigh. The unit continuously adjusted the pressure to maintain 80% occlusion through the training program and upon completion at 6 weeks. Results indicated that at the end of the 6-week program the 15% deficit had improved to an 8% advantage over the uninvolved leg for a total percentage change of 27%. Girth measurement also increased by 1.5 cm.

DISCUSSION: Blood flow restriction training has been used to improve quadriceps strength and muscle size. It has been used for increasing strength post injury or surgery, during immobilization and in the elderly. It has been used to augment traditional strength training in athletes. The patient in this case had been active with sports and normal exercise routines that included traditional strength training, college football and high intensity interval training since the time of injury. Despite remaining active and fully recovering range of motion and normal strength, as graded with a manual muscle test, atrophy remained 25 years later. Upon completion of 6 weeks of blood flow restricted training, hypertrophy and improved strength were noted; these changes were not able to be achieved in the past with traditional strength training at higher intensities and resistances.


OP020
VALIDITY AND RELIABILITY OF THE ANGLES VIDEO GONIOMETER APP FOR THE ASSESSMENT OF JOINT ANGLES IN CHILDREN AND ADULTS
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PURPOSE: Existing tools for measuring joint angles have key limitations. Goniometers do not allow for measurement while people engage in functional activities.1 Software programs that calculate joint angles from video or photos require a computer.2,4 The Angles Video Goniometer app (Angles) aims to provide an affordable solution for assessing range of motion across a variety of environments and during meaningful tasks. The purpose of this study was to assess the reliability and validity of joint angle measurements from the Angles app in adults and children.

DESCRIPTION: Angles is an iPad application that serves as a goniometric tool to measure joint angles from video. Its intrarater and interrater reliability was assessed by independent rescorings of all videos in the sample. Its validity was evaluated by comparing: (1) joint angles obtained from Angles to those acquired from a previously validated computer-based goniometer software Kinovea;5 (human subjects assessment described below); and (2) angles obtained from Angles to those recorded from a mechanical goniometer (20 angles were drawn on a whiteboard, measured with a goniometer, then videotaped with an iPad and marked using Angles).

SUMMARY OF USE: Twenty adults (7 male, 18-42 years old) and 20 children (12 male, 7-14 years old) participated in a standardized protocol of movement (ie, holding self-selected shoulder and elbow positions) and functional activities (ie, squatting, reaching, walking) video recorded by an iPad in the sagittal or frontal plane. Shoulder and elbow self-selected angles, maximum hip flexion and extension, and maximum shoulder flexion and extension were measured by using the app to mark the observed joint centers. The app then calculated the associated angles and output the
Ultrasound is a painless, reliable clinical tool that can be used to detect synkinesis, or involuntary movements of the face as a result of injury to the facial nerve. Ultrasound has changed the diagnosis and treatment of 7 of 29 patients who were referred to our center for shoulder pain. In these cases, facial action potentials and synkinesis were not detected on the healthy side in any of these cases. Additionally, we utilize ultrasound as a biofeedback tool for neuromuscular retraining.

PURPOSE: The goal of this study was to compare the reliability of passive straight leg raise (PSLR) and passive popliteal angle measurements using a goniometer and a talus inclinometer. The most reliable method and testing device for assessing hamstring length and often utilize a goniometer or digital inclinometer. The most reliable method and testing device for assessing hamstring length and often utilize a goniometer or digital inclinometer. The most reliable method and testing device for assessing hamstring length and often utilize a goniometer or digital inclinometer. The most reliable method and testing device for assessing hamstring length and often utilize a goniometer or digital inclinometer. The most reliable method and testing device for assessing hamstring length and often utilize a goniometer or digital inclinometer.

MATERIALS/METHODS: Three testers (1 with 10 years of orthopaedic physical therapy experience and 2 first-year physical therapy students) performed measurements during 2 testing sessions (3-7 days between sessions). Passive straight leg raise measurements were performed with the knee in full extension for each limb. Passive popliteal angle measurements were performed by extending the knee from 90° while maintaining the hip in 90° of flexion for each limb. Interrater and intrarater reliabilities were calculated in SPSS using interclass correlation coefficients (ICC). Minimal detectable change (MDC) was also calculated (standard error of the measure ± 2 standard deviations).

RESULTS: For passive straight leg raise measurements using a goniometer, interrater reliabilities were fair (ICC = 0.59 and 0.50, respectively) and between session intrarater reliabilities were good to excellent for all raters (ICC = 0.74-0.94). For passive straight leg raise measurements using an inclinometer, interrater reliabilities were excellent (ICC = 0.82 and 0.89). For passive popliteal angle measurements using a goniometer, interrater reliability was excellent (ICC = 0.77) and between session intrarater reliabilities were good to excellent for all raters (ICC = 0.66-0.91). For passive
popliteal angle measurements using an inclinometer, intrarater reliability was excellent (ICC = 0.85). MDC values were as follows: passive straight leg raise: 4.5° to 9.09°, passive popliteal angle 3.92° to 8.65°.

CONCLUSIONS: Both passive straight leg raise and passive popliteal angle demonstrated good to excellent intrarater reliabilities; however, passive popliteal angle measurements had higher interrater values. Additionally, the inclinometer yielded higher intrarater values for passive straight leg raise and popliteal angle measurements. The MDC values did not vary substantially between passive straight leg raise and passive popliteal angle measurements.

CLINICAL RELEVANCE: The most reliable measures of hamstring length are obtained using popliteal angle and intrarater reliability was superior using an inclinometer as compared to a goniometer. This is important clinically because hamstring length measurements are commonly used in the clinic to evaluate persons with lumbar spine or lower extremity pathology.

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ATLANTOAXIAL INSTABILITY IN A PATIENT WITH NECK PAIN AND RHEUMATOID ARTHRITIS

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BACKGROUND AND PURPOSE: When evaluating patients with neck pain with a history of trauma or a condition that may render the structures of the upper cervical spine incompetent, physical therapists should be alert for the presence of atlantoaxial instability. The purpose of this report is to describe the clinical decision-making process for a patient referred to a physical therapist with neck pain with underlying atlantoaxial instability.

CASE DESCRIPTION: The patient was a 47-year-old woman diagnosed with rheumatoid arthritis 13 years earlier. She was referred to a physical therapist by her rheumatologist for the treatment of worsening upper neck pain that began insidiously 1 year prior. The patient denied numbness or tingling in her upper or lower extremities, dizziness or lightheadedness, difficulty maintaining balance with walking, or muscle weakness. Magnetic resonance imaging of her cervical spine completed 8 months earlier revealed marrow signal changes of the odontoid and multilevel mild degenerative spondylolisthesis. Flexion and extension radiographs of the cervical spine completed 1 week prior to the physical therapist's initial evaluation were interpreted as unremarkable with alignment preserved in flexion and extension. At the time of the physical therapist's initial evaluation, cervical spine range of motion was moderately limited in flexion and mildly limited in extension and bilateral cervical rotation due to pain and apprehension. The patient's neurological examination was unremarkable. Palpation of the cervical spine revealed regional paraspinal guarding. A Sharp-Purser test was performed, which was positive for excessive motion.

OUTCOMES: The flexion and extension radiographs of the cervical spine were then reviewed by the physical therapist with the rheumatologist, which revealed inadequate cervical motion, which may have limited the diagnostic utility of the radiographs. Flexion and extension radiographs of the cervical spine were then repeated ensuring the patient adequately flexed and extended during the imaging. Severe anterior subluxation of C1 relative to C2 with cervical flexion was noted; more specifically, C1 moved as much as 8 to 9 mm anterior to C2 with cervical flexion. This finding warranted immediate referral to a neurosurgeon and the patient subsequently underwent successful posterior fusion from the occiput to C2.

DISCUSSION: In this case, several factors related to the history (ie, history of rheumatoid arthritis) and physical examination (ie, moderately decreased cervical spine range of motion, positive Sharp-Purser test) were concerning for atlantoaxial instability. Additionally, after determining that the initial flexion and extension radiographs of the cervical spine were of limited the diagnostic utility due to inadequate motion, the radiographs were repeated properly. This led to a diagnosis of underlying atlantoaxial instability, followed by appropriate surgical management. This case report demonstrates the importance of properly screening for upper cervical spine instability in patients with neck pain.


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MANAGEMENT OF DISTAL RADIUS FRACTURE BY CERTIFIED HAND THERAPISTS: A QUALITATIVE STUDY

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PURPOSE/HYPOTHESIS: Distal radius fractures (DRF) are associated with adverse health outcomes such as risk for future falls, fall-related fragility fractures1 and functional decline.2 Approaches to screen the individuals at risk for falls and functional decline after DRF have been identified3 and physical therapists (PT) are well-trained to implement such risk screening. However, a comprehensive audit of current approaches to manage DRF is required to understand research-to-practice gaps in managing DRF before knowledge translation to implement such risk screening in PT practice can be designed. This study examined the current approaches of certified hand therapists (CHT), who are upper extremity (UE) rehabilitation specialists, in managing DRF.

NUMBER OF SUBJECTS: Ten.

MATERIALS/METHODS: A semi-structured qualitative interview of 10 certified hand therapists (CHT) was conducted by a student PT (SPT) to gain understanding of their management of DRF. Interview questions sought details of approaches used for interview, assessment, and treatment of DRF patients. Additional probes were used as necessary to understand or clarify the comments. Interviews were audiotaped for subsequent verbatim transcription. The senior investigator and 3 SPT independently reviewed the transcribed information to identify the codes before meeting to compare their coding. The codes were used to assist with clustering the relevant information into succinct concepts which were combined to create themes.4 Data collection stopped once the breadth of information provided by subsequent interviewees was saturated.

RESULTS: Inquiring about the mechanism of wrist injury and gathering information about general health and comorbid burden were key areas captured during the patient interview. Only 3 CHTs inquired about osteoporosis with 1 asking about history of falls. Assessment of wrist/hand movements and edema, obtaining self-reports of pain and UE functions, and examining sensori-motor impairment were the components of objective assessment for the CHTs. However, none conducted a targeted assessment of fall-risk or functional mobility. The initial management of DRF included an exercise program to restore wrist/hand mobility and interventions to control pain (eg, thermal agents, splints).2 Two CHTs reported integrating functional training of the wrist/hand, whereas 1 considered patient education for the DRF injury and prognosis was crucial. None of them administer interventions to address fall risk.
CONCLUSIONS: Despite clear evidence suggesting the elevated risk for falls and functional decline in a subset of patients with DRF, CHTs do not address aspects of fall-risk and functional mobility in assessment or treatment of DRF. This is an unfortunate but an important research-to-practice gap in managing DRF.

CLINICAL RELEVANCE: The results of this study will familiarize PTs about an important research-to-practice gap in managing DRF. They will facilitate development of strategies to integrate screening the risk for falls and functional decline in patients presenting for the rehabilitation of DRF.

OP026

RELIABILITY OF THE LASER-POINTER-ASSISTED ANGLE REPRODUCTION TEST IN HEALTHY VOLUNTEERS

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PURPOSE/HYPOTHESIS: Developed to test shoulder proprioception, the laser-pointer assisted angle reproduction test (LPART) is clinically applicable and easy-to-use. This test uses a large grid with targets located at different heights for testing various shoulder elevation angles. It has been shown to quantitatively assess shoulder reproduction differences between healthy controls and patients with shoulder disorders. Prior to physical therapists using this test as an objective measure during rehabilitation, psychometric properties of this test need to be established. The purpose of this study was to determine test-retest reliability of the LPART.

NUMBER OF SUBJECTS: Twenty healthy subjects (16 female; mean age, 24 years).

MATERIALS/METHODS: All subjects completed the SPADI, a short history, and underwent a brief physical exam of the neck and shoulders to ensure the subject had no current complaints or symptoms. The right shoulder was tested on all subjects. Setup for LPART was completed according to Balke et al., in our case however, the laser-pointer was affixed to wrist using prewrap and paper tape. Three standardized target locations (125°, 90°, 55°) of shoulder flexion were marked on the grid. Subjects were allowed 30 seconds to familiarize themselves with each target location with eyes open. Subjects were blindfolded and asked to move the laser-pointer from hanging at their side to a randomized order of 15 target locations (5 per target). Each laser-pointer position was marked on the grid and the subjects returned to the start position. Each of the 15 points was measured as the horizontal (x) and vertical (y) distance from the target (origin). These points were used to calculate the location of the mark using the Pythagorean theorem. Subjects were blinded from their results on test day 1 so as not to influence their follow-up test. In order to evaluate test-retest reliability, subjects followed up within 7 days of the original test. The intraclass correlation, ICC model 1.2 and the 95% confidence interval (CI) were used to assess between days repeatability. Bland-Altman methods were used including the mean difference between measures, and the 95% CI for the difference, the standard deviation of the difference, and the 95% limits of agreement of the measures. The test was evaluated overall, and specific to target location.

RESULTS: Across all targets between days, there was a mean difference of 0.34° ± 4.64°, with 95% limits of agreement of –8.94 to 9.63, and good-excellent test-retest reliability. Bland-Altman plots suggest that 75% of mean deviations fell within 1 standard deviation of the mean difference. The most accurate and reliable target was 90°, followed by 125° then 55°.

CLINICAL RELEVANCE: The LPART is a simple, inexpensive test that is reliable for testing shoulder flexion proprioception between days.

OP027

DIFFERENCES IN KNEE MECHANICS BETWEEN RUNNERS WITH HIGH AND LOW QUADRICEPS RATE OF TORQUE DEVELOPMENT

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PURPOSE/HYPOTHESIS: Lower extremity strengthening exercises have been shown to improve pain without producing any changes in the gait pattern of injured runners. The role of muscle strength on running mechanics continues to not be well understood. A need remains to better understand the link between strength and mechanics in order to improve physical therapy interventions. Previous studies have used peak isometric strength, which is achieved at greater than 300 milliseconds, while most dynamic movements are performed in less than 150 milliseconds. This suggests that utilizing rate of muscle torque development (RTD) rather than peak muscle torque production may better reflect the relationship between muscle function and gait mechanics during running. Thus, the purpose of this study is to define the relationship of knee extension (KE) RTD to peak knee flexion angle during running.

NUMBER OF SUBJECTS: Eighteen subjects (mean ± SD age, 22.7 ± 0.97 years; 6 male, 12 female; height, 1.70 ± 0.10 m; weight, 62.53 ± 9.94 kg). Subjects were recreational runners (average ± SD experience running, 7.31 ± 4.42 years; 20.39 ± 12.21 mi/wk) who had no prior history of LE injury.

MATERIALS/METHODS: An instrumented gait analysis was performed with the subject running at 3.0 m/s. An electromechanical dynamometer was used to test isometric KE with the knee flexed to 90°. The data were post-processed in custom software to calculate knee joint angles during the stance phase of running and RTD of the isometric KE trials. RTD was calculated as the slope of the linear rise in the torque-time curve after trial initiation. Subjects were equally divided into 2 groups based on RTD (ie, “Low RTD” and “High RTD”). Independent 2-sample t tests were used to detect between-group differences.

RESULTS: There was a significant difference in KE RTD (P < .001) between the high RTD (712.56 ± 166.35 Nm/kg/s) and low RTD (432.29 ± 96.91 Nm/kg/s) groups. Additionally, a significant difference in peak knee flexion angle (P < .02) between High RTD and Low RTD groups was found (58.07° ± 2.68° versus 53.33° ± 4.68°).

CONCLUSIONS: Runners with greater KE RTD have greater peak knee flexion angle during the stance phase of running. Runners with greater KE RTD may be better able to control knee motion and thus are able to go into a deeper knee joint angle. In contrast, runners with lower KE RTD demonstrate less knee flexion consistent with a quadriceps-avoidance gait pattern, likely to reduce demand on the quadriceps.

CLINICAL RELEVANCE: Runners with greater KE RTD are able to better control knee flexion motion during running. With more knee flexion, forces are better attenuated through the quadriceps muscle rather than transmitting through the knee joint itself, potentially decreasing the stress at the joint. Interventions such as power training to increase RTD of the knee extensors may be beneficial during the later stages of rehabilitation and in injury prevention programs.

OP028

RECOMMENDED TREATMENT INTERVENTIONS AFTER MANIPULATION UNDER ANESTHESIA: A CASE STUDY OF A RECREATIONAL ROWER AFTER TOTAL KNEE ARTHROPLASTY

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BACKGROUND AND PURPOSE: Total knee arthroplasty (TKA) has evolved to become a satisfactory procedure for the treatment of end stage degenerative knee pathologies. Though often successful, 1% to 13% of cases result in persistent arthrofibrotic stiffness. Treatment options for arthrofibrotic stiffness include aggressive physical therapy, manipulation under anesthesia (MUA), debridement, and revision. Limited evidence exists to guide physical therapy interventions to optimize individuals’ outcomes following MUA. The purpose of this case study is to highlight the success of specific physical therapy interventions following a MUA in a recreational rower.
CASE DESCRIPTION: This retrospective case study of a 75-year-old man highlights the effectiveness of physical therapy interventions after a MUA secondary to failure of conservative management following a primary TKA. Initial treatment focused on effusion management, prolonged static stretching, use of a stationary bike, and manual interventions addressing soft tissue and joint mobility restrictions. Two weeks after the MUA, greater emphasis was placed on gait training, open chain strengthening and muscle activation strategies. In the final stages of rehab, exercises were progressed to include closed chain strengthening (squats, leg press, wall sits), functional training and sport-specific training.

OUTCOMES: Nineteen days after the primary TKA the patient presented at initial evaluation with max pain levels of 9/10, knee extension AROM of lacking 10° and knee flexion AROM to 70°. After 5 visits the patient demonstrated poor outcomes noting pain levels of 7/10, knee extension AROM of lacking 3° and knee flexion AROM to 95°; therefore, the decision was made to perform a MUA. Following the MUA (30 days post primary TKA) the patient participated in a comprehensive PT program consisting of 19 visits over an 11 week time frame. The patient demonstrated improvements in pre/post MUA pain levels (7-0); knee flexion AROM (95°-134°), and knee extension AROM (lacking 3°-0°). KOOS-PS score values improved from a raw score of 24/28 to 5/28 and SLS times of 0 seconds to 27 seconds from the time of his initial evaluation to discharge respectively. He was able to return to recreational rowing 75 days after the MUA, in addition to independent level surface and stair ambulation.

DISCUSSION: This case study suggests aggressive PT interventions and a home exercise program after a MUA can lead to excellent outcomes. PT initially focused on acute management as well as joint and soft tissue restrictions. This was then followed by a progressive strengthening and motor control program. Lastly, introduction of sport-specific training was utilized resulting in the patient's ability to return to recreational rowing. Subjectively, the patient demonstrated improved ROM, pain levels, SLS time and KOOS-PS scores suggesting that the performed interventions may be useful in similar individuals who have undergone an MUA.


OP029

AN ELECTROMYOGRAPHIC ANALYSIS OF COMMON THORACIC EXERCISES: IMPLICATIONS FOR REHABILITATION

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PURPOSE/HYPOTHESIS: Thoracic extensor resistance exercise is used for persons with thoracic spine pain, to improve posture and prevent osteoporotic fractures. Much research has examined exercises intended to train the lumbar extensors, however research of exercises intended to train the thoracic extensors is limited. The purpose of this study was to examine thoracic extensor muscle activity during thoracic resistance exercises used in rehabilitation. Specific aims: (1) determine which exercises elicit greater thoracic than lumbar activity, (2) examine side-to-side differences for unilateral exercises (3) identify regional differences and (4) rank exercises.

NUMBER OF SUBJECTS: Twenty-six healthy adults (14 male, 12 female).

MATERIALS/METHODS: Fine-wire electrodes were unilaterally inserted with ultrasound guidance into both the multifidus and longissimus muscles at the T7 and T11 spinal levels. Surface electrodes recorded L5 multifidus activity. Subjects performed maximum voluntary contractions (MVCs) for thoracic and lumbar muscle groups. Raw EMG signals were sampled at 2000 Hz with a 10-Hz high-pass filter. Subjects performed 16 exercises: Ipsilateral (1-) Contralateral (C-) and Bilateral (B-) Arm Raise on Ball (ARB) with or without Resistance (R), Resisted Seated Shoulder Flexion (RSSF), Prone Trunk Lift (PTL) with (R) and without, Prone Overhead Flexed Elbow Raise (POFER), Bird Dog (1- and C-BD), Scapular Retractions (SR) and Resisted Bilateral External Rotation (RBER). Five repetitions of each were performed using a metronome to pace the movements. The mean root-mean-square of the EMG signal in each exercise was normalized to MVC for each muscle. Paired t tests compared averaged thoracic activity to lumbar multifidus activity. A 3-way repeated-measures ANOVA compared between sides in unilateral exercises. A 2-way repeated measures ANOVA compared between thoracic levels across all exercises. A 3-way repeated-measures ANOVA determined rank between exercises across thoracic muscles and levels.

RESULTS: All exercise achieved greater average thoracic muscle activity than lumbar (P<.05). The side ipsilateral to the arm lifted during unilateral exercises had significantly greater activity (range, 4.7%-16.7% MVC; P<.01) during ARB, ARB-R and I-BD. Average T7 muscle activity was greater than that of T11 during I-BAR, B-BAR, B-BAR-R, I-SRSF, B-SRSF SRT-3, POFER and I-BD (range, 6.1%-14.7% MVC; P<.05). In rank, POFER average thoracic muscle activity exceeded that of all other exercises (36.9% MVC; P<.02), followed by PT-L R (31.5% MVC) and B-BAR-R (30.1% MVC).

CONCLUSIONS: Thoracic extensor exercises used in rehabilitation generally elicited low to moderate muscle activity suggesting these exercises have more potential benefits for developing endurance rather than strength.

CLINICAL RELEVANCE: Depending on the needs of the patient, the results suggest exercise options for training one side of the extendors and options for targeted training effects at the T7 region. The results may lead to more effective exercise prescription for patients with thoracic spine disorders.

OP030

USE OF NEUROMUSCULAR ELECTRICAL STIMULATION DURING PHYSICAL THERAPY REDUCES THE INCIDENCE OF ARTHROFIBROSIS AFTER TOTAL KNEE ARTHROPLASTY

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PURPOSE/HYPOTHESIS: Total knee arthroplasty (TKA) is a highly effective procedure for late stage knee arthritis. Despite its effectiveness, complications such as arthrofibrosis can develop, leading to increased costs and decreased patient satisfaction. This can be critical for health care institutions with contracted bundled payment care initiative options or comprehensive care for joint replacement models. Early physical therapy has been demonstrated to reduce the incidence of knee arthrofibrosis; however, arthrofibrosis may still develop. The use of neuromuscular electrical stimulation (NMES) has been demonstrated to facilitate quadriceps muscle recovery and reduce pain, which in theory may help improve knee range of motion and reduce the incidence of arthrofibrosis. However, to our knowledge this has not been directly tested. Therefore, the purpose of this study is to assess the effect of NMES use in reducing the development of arthrofibrosis. Specifically, we assessed rates of manipulation under anesthesia (MUA) and calculated the odds of having developed arthrofibrosis in patients who underwent physical therapy with and without NMES.

NUMBER OF SUBJECTS: We reviewed records of 410 patients that underwent primary Total Knee Arthroplasty. Patients who had a history of drug abuse, inflammatory arthropathies, or prematurely dropped out the phys-
LUMBAR RADICULOPATHY TREATMENT BASED ON IRRITABILITY: A CASE SERIES

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BACKGROUND AND PURPOSE: Lumbar spinal stenosis (LSS) is an increasingly prevalent issue in health care and is one of the leading causes of low back pain in individuals to date. Recent studies have estimated that low back pain accounts for over 100 billion health care dollars per year in the United States. Epidemiological studies have estimated that the prevalence of individuals with LSS can be as high as 23.6%. In an effort to conservatively diagnose LSS, Cook created a clinical prediction rule (CPR) in 2011. Despite the prevalence of LSS, few studies have provided a decisive algorithm with which to guide conservative care for patients with LSS. Consistent with Miller-Spoto and Gomatto's 2014 work, the STAR method used for the shoulder, and Fritz, Cleland, and Childs' 2007 work, the aim of this case series was to use a self-derived algorithmic approach to evaluate and treat LSS with explicit guidelines based on patient history, impairments, and irritability levels in an effort to systematically decrease the impairments associated symptomatic LSS patients.

CASE DESCRIPTION: Four patients were seen in an outpatient physical therapy setting from October 2016 to March 2017 for treatment of LSS. The inclusion criteria were consistent with each patient meeting at least 3 predictive variables in Cook's 2011 CPR for LSS (0.88 specificity for LSS with 3+ predictive variables). Each patient in the study completed standardized outcome measures at evaluation and discharge including the Fear-Avoidance Beliefs Questionnaire for Physical Activity (FABQ-PA), numeric pain-rating scale (NPRS), and the Focus On Therapeutic Outcomes, Inc (FOTO). Passive hip internal rotation (HIR) and hip external rotation (HER), lower extremity reflexes associated with the L4 and S1 spinal nerve roots, and seated lumbar flexion and extension were all assessed in short sitting. Patients were treated based upon the evaluative and rehabilitative algorithm for LSS derived for this case series.

OUTCOMES: Three out of the 4 patients treated for LSS demonstrated significant improvement in FOTO primary measure scores. All 4 patients saw an increase in symmetry for hip rotation measurements. Patient 4 experienced a decrease in FABQ-PA scores. Three patients experienced improvements in pain. All patients experienced normalized deep tendon reflexes in both of the associated nerve roots.


MANAGING NONOPERATIVE CHIARI I MALFORMATION BY REDUCING DURAL TENSION

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BACKGROUND AND PURPOSE: Chiari I Malformation (CIM) is a herniation of the cerebellar tonsils at least 3 mm below the foramen magnum. Due to obstruction of cerebral spinal fluid or compression of the brainstem, CIM cause symptoms including headaches, nausea, dysmetria, and upper extremity numbness, pain, and weakness. It has been suggested that increased tension on the spinal cord can progress symptoms, but there is a lack of evidence to guide conservative management of CIM. The purpose of this case is to present physical therapy (PT) management of a patient with symptoms suggestive of CIM.

CASE DESCRIPTION: The patient was a 38-year-old man with insidious onset of bilateral upper extremity pain 20 years ago. In 2016, electrodiagnostic testing of the brachial plexus was unremarkable, and an MRI of his upper cervical spine revealed a 3 mm cerebellar tonsil herniation. Because a neurology consultation deemed him a nonsurgical candidate, his primary care physician referred him to PT to address midline thoracic pain, headaches, and bilateral upper extremity weakness and paresthesias. Initial PT examination ruled out upper cervical ligamentous instability and cervical radiculopathy. Because imaging ruled out spinal cord compression, and electrodiagnostic testing ruled out brachial plexus pathology, dural tension testing via median nerve upper limb tension testing (ULTT) was selected as an exam component. ULTT caused the patient's familiar paresthesias, neck pain, nausea, and headaches. Thoracic joint play with posterior-anterior mobilizations caused familiar nausea. It was hypothesized that these tests provoked symptoms by tensioning the brachial plexus and spinal cord dura, and therefore increased pressure on the cerebellar tonsill herniation. Subsequently, interventions focused on minimizing upper quarter dural tension. Six treatment sessions were administered over 6
months. Interventions focused on reducing dural tension to minimize tension on the spinal cord, and included leukotaping the patient's shoulders in elevation, and education on self-taping and limiting upper extremity movements that increase dural tension.

OUTCOMES: Between the first and final visit, the patient's headache pain scores decreased from a 10 out of 10 on the verbal response scale to a constant 3. Thoracic pain worsened from a 7 at initial visit to an 8. The patient subjectively reported an improvement from feeling upper extremity paresthesias constantly to only in the evenings. Grip strength increased from 47 lb to 58 lb in the right, and 62 lb to 67 lb in the left. Five-time finger-to-nose testing improved from 9 to 2 errors.

DISCUSSION: This case demonstrates a correlation between interventions to reduce tension on the spinal cord and an improvement in common CIM symptoms (specifically upper extremity paresthesias, grip strength, headache intensity, and dysmetria) and worsening thoracic pain for an individual with nonoperative CIM. Clinicians may consider management of dural tension as a treatment option for individuals with symptomatic but non-surgical CIM.


OP033
DIFFERENTIAL DIAGNOSIS AND MEDICAL SCREENING OF A YOUNG MALE WITH IDIOPATHIC FOOT DROP

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BACKGROUND AND PURPOSE: Lyme disease (LD) is common among younger males and is typically diagnosed by laboratory tests, when clinical signs and symptoms are present. LD often presents with widespread musculoskeletal and nervous system impairments, including peripheral neuropathy. Due to physical therapists (PTs) knowledge of the musculoskeletal system, atypical presentations, such as LD must be recognized. This case report describes the medical screening, referral, and treatment of idiopathic foot drop, caused by LD.

CASE DESCRIPTION: A 13-year-old adolescent boy was referred to PT from his pediatrician (MD) for idiopathic foot drop and a suspected compressive neuropraxia after sleeping in a recliner. Subjective reports included foot and ankle paresthesia, limited ankle range of motion and strength, and impaired ability to walk. Physical examination revealed hypoesthesia along common, deep, and superficial peroneal nerve distributions, a lack of dorsiflexion (DF) active range of motion of 40°, and motor impairments (0/5) to TA, EHL, EDL, PL, and PB. Single leg stance testing was maintained 5 seconds, compared to 30 seconds on the uninjured limb. FAAM (Foot and Ankle Ability Measure) indicated 63% (ADL) and 35% (sports) perceived ability. Assessment of central and segmental nervous system function, lumbar spine, and peripheral joint mobility was unremarkable. Further discussion revealed symptom onset 5 days after flu-like symptoms. Based on this emerging information, the amount of functional loss without a proportionate mechanism of injury, and the high incidence of tick-borne illness in the mid-Atlantic region, a nonmusculoskeletal origin was suspected.

OUTCOMES: Referral back to MD resulted in antibody tests that confirmed LD. He was referred back to PT and prescribed Doxycycline for 4-weeks.

PT intervention included neuromuscular re-education through therapeutic exercise, neuromuscular electrical stimulation, and manual therapy. After 9 visits of PT, he presented with DF AROM of 5°, ankle/foot manual muscle testing measured 4/5 for TA, EHL, EDL, and 5/5 for PL and PB, he demonstrated the ability to return to sport specific tasks of single leg hopping, box jumping, and agility training, and his FAAM indicated 100% perceived ability for ADLs and sports. He was discharged after 9 visits and successfully returned to competitive sports.

DISCUSSION: This case highlights the importance of medical screening and utilization of a PTs clinical role to timely identify impairments from LD induced unilateral peripheral neuropathy. Appropriate medical screening and appropriate triage enabled the proper diagnosis, medical management, and facilitated successful completion of rehabilitation, which allowed him to return to sports. PTs should include LD as a differential diagnosis for idiopathic peripheral neuropathy, particularly when atypical musculoskeletal presentation is seen in regions known for higher incidence of tick-borne diseases.


OP034
DOES PAYER TYPE IMPACT OUTCOME SCORES OF LOW BACK PAIN PATIENTS PRESENTING TO OUTPATIENT PHYSICAL THERAPY?

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PURPOSE/HYPOTHESIS: The purpose of this study was to compare physical therapy outcome scores of medicaid and privately insured patients presenting with low back pain in an outpatient orthopaedic setting. It is hypothesized that medicaid patients will have less improvement on the Oswestry Disability Index from initial evaluation to discharge as compared to privately insured patients.

NUMBER OF SUBJECTS: Six hundred eighteen.

MATERIALS/METHODS: This retrospective study sample was identified from an internal database of functional outcomes scores of a multiclinic outpatient orthopaedic private practice company in the New England region of the United States. Patient’s name, diagnosis, primary insurance, ODI score at initial evaluation and discharge were all identified from a date range of January 1, 2015 to October 1, 2016. Data were then placed into SPSS software for statistical analysis.

RESULTS: Results of the statistical analysis revealed no significant difference in change in scores between initial evaluation and discharge for both insurances. Further statistical analysis revealed patients with medicaid insurance had higher overall scores on the ODI at both initial evaluation and discharge when compared to private insurance patients at the same time points (Medicaid at initial evaluation: mean, 45% versus private insurance at initial evaluation: mean, 33%, and Medicaid average at discharge, 29.5% versus private insurance mean at discharge, 17%; P = .981). When looking at whether patients met the minimally clinical important difference of 10% change in scores for the ODI, both insurance types met this requirement with both having an average improvement in score of 15.8%.

CONCLUSIONS: Although average change in scores from initial evaluation to discharge in both insurances did meet the MCID of 10% improvement on the ODI showing significant improvement, medicaid patients had a high-
er disability score as compared to private insurance patients upon initial evaluation and discharge. Patients with medicaid were also categorized as severely crippled upon initial evaluation based on categorization of disability set by Vianin 2008. At discharge patients with medicaid were still in the moderately disabled category. In comparison patients with private insurance came in only moderately disabled and were discharged from physical therapy with minimal disability.

**CLINICAL RELEVANCE:** Patients with medicaid insurance tend to be of low socioeconomic class, have higher rates of multiple comorbidities, and have poor perceptions and understanding of health care which may contribute to these higher levels of disability. It is important that physical therapists be aware of these factors when treating this patient population and take a more biopsychosocial approach to treatment as this may help to improve patients self reported disability and progress patients more effectively and efficiently through physical therapy for the treatment of low back pain.

**REFERENCES:**

**OP037**

**COMPARISON OF LOWER-LEG MUSCLE ACTIVITY BETWEEN 2 BALANCE DEVICES DURING SQUAT-AND-LUNGE EXERCISE**

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**PURPOSE/HYPOTHESIS:** Unstable devices have been used as therapeutic adjuncts for prevention or following a lower extremity injury. Some examples of unstable platforms include balancing on a device (BOSU ball) or wearing the device over a shoe (StepRight Stability System). Multi-directional instability may be greater wearing an unstable device compared to stepping onto an unstable platform; however, it is unknown how these forms of instability affect lower-leg muscle activity during exercise. Thus, the purpose of this study was to compare lower-leg muscle activity across 3 surfaces (StepRight Stability System, BOSU ball, and firm) during a forward lunge and squat exercise. The hypothesis tested was that the StepRight Stability System would result in greater muscle activity compared to BOSU ball or firm surfaces.

**NUMBER OF SUBJECTS:** Eighteen subjects, aged 20 to 25 years, with no known musculoskeletal or balance impairments.

**MATERIALS/METHODS:** Surface electrodes were applied to tibialis anterior (TA), lateral gastrocnemius (LG), and fibularis longus (FL). Maximum voluntary isometric contraction (MVIC) of the 3 muscles were performed and used to normalize muscle activity and expressed as percentage of MVIC (percent MVIC). Subjects were assigned a random order of condition (StepRight, BOSU ball, and firm surface) and exercise (forward lunge, squat). A metronome was used to standardize exercise motions. The middle 3 of the 15 repetitions for each exercise were converted to a mean and used for data analysis. One-way analyses of variance were used to determine effect of condition and exercise, with Bonferroni post hoc tests to specify significant main effect differences.

**RESULTS:** The 3 conditions produced low (less than 20% MVIC) to moderate (21%-40% MVIC) activity for FL, LG, and TA during the squat. The forward lunge standing on firm surface and BOSU ball resulted in moderate FL, LG, and TA activity and the StepRightTM high (greater than 40% MVIC) levels for FL and TA. Significant percent MVIC differences were found wearing the StepRight during the forward lunge (concentric and eccentric FL: 50% MVIC) and (eccentric LG: 39% MVIC), (P<0.001). The BOSU ball while squatting was highest for (concentric and eccentric LG: 25% MVIC) and (concentric FL: 26% MVIC), (P<0.05) compared to other surfaces.

**CONCLUSIONS:** Performing bilateral squats while standing on firm surface or BOSU ball or wearing the StepRightTM produced low to moderate percent MVIC whereas the forward lunge elicited moderate to high percent MVIC across the 3 conditions. The StepRight resulted in the highest percent MVIC (fibularis longus) during the forward lunge in both the down and up phases of the exercise.

**CLINICAL RELEVANCE:** These findings provide information for clinicians regarding exercise prescription. Bilateral squats and forward lunges either standing on firm surface, BOSU ball, or wearing the StepRight would be most effective for low to moderate endurance exercises for the lower leg muscles, and wearing the StepRight during forward lunges could also strengthen tibialis anterior and fibularis longus muscles.

**OP038**

**QUANTIFYING GROUND REACTION FORCES OF DOUBLE- AND SINGLE-LEG PLYOMETRIC EXERCISES IN A HORIZONTAL, GRAVITY-MINIMIZED POSITION**

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**PURPOSE/HYPOTHESIS:** Knee pathology is commonly treated in physical therapy. Shuttle training is one approach to treat individuals with knee pathology by introducing submaximal loading in a gravity minimized position. However, there is minimal data quantifying peak ground reaction forces (GRF) using gravity minimized closed kinetic or open kinetic chain shuttle exercises. This study aims to provide empirical evidence demonstrating the peak GRFs for concentric and eccentric phases of various plyometric exercises with varying levels of resistance in a gravity minimized position. We investigated 2 hypotheses: (1) there will be significant differences in peak GRFs as resistance increases, and (2) there will be no significant differences in peak GRFs between concentric and eccentric phases.

**NUMBER OF SUBJECTS:** Fifty healthy and physically active subjects, 21 men and 29 women.

**MATERIALS/METHODS:** Each participant performed 1 set of 4 repetitions of 4 exercises at 3 separate levels of resistance (2, 2.5, and 3 bands) using the Shuttle MVP 3300 (Huntington, NY). Force data were recorded using an AMTI force plate (OR6, Watertown, MA) and kinematic data were captured with an electromagnetic tracking system (The MotionMonitor, Chicago, IL). Sixteen subjects returned for a second session to establish test-retest standard error of measurement (SEM).

**RESULTS:** Larger absolute reliability was revealed for the double leg (SEM, 0.01-0.15 body-weight units [BWU]) exercises than the single leg exercises (SEM, 0.05-0.16 BWU). For the double leg exercises, a 3-way mixed ANOVA with repeated measures revealed a significant resistance level effect on peak GRF (P<0.001). Post hoc interaction contrasts of a significant sex by band by phase interaction (P = .017) revealed a significant band by phase interaction for women (P<0.001), whereas there was only a significant resistance effect for the men (P<0.001). Simple main effect post hoc analysis of resistance by phase interaction for the women revealed no differences between phases for 2 bands (P = .275, d = 0.14) or 2.5 bands (P = .383, d = 0.08); however, there was a phase difference between 2 and 3 bands (P = .001, d = 0.46). For the men, 2.5 bands was significantly greater than 2 bands (P = .004, d = 0.26) and 3 bands was significantly greater than 2.5 bands (P<0.001, d = 0.57).

**CONCLUSIONS:** The results support the first hypothesis that there would be a significant band effect. The second hypothesis was also supported overall; however, there were differences between phases for women during the single leg plyometric jump with 3 bands. This is likely due to a stiffer landing as the women reached their maximal landing response.

**CLINICAL RELEVANCE:** After knee injuries, clinicians are always seeking ways to provide a progressive loading response to enhance muscular performance. Based on the results of this study, using the shuttle and varying the band resistance may provide another safe option.

**OP039**

**REHABILITATION OF A 54-YEAR-OLD FEMALE CONSTRUCTION WORKER FOLLOWING A STERNOCLOACULAR JOINT RECONSTRUCTION 5 YEARS POST INJURY: A CASE REPORT**

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**BACKGROUND AND PURPOSE:** Ligamentous instability of the sternoclavicular joint (SCJ) results in decreased functional movement in the upper extremity (UE). The SCJ is not commonly injured and specific protocols on how to treat patients with SCJ dysfunction are not established. The purpose of this case report is to review a plan of care utilized after an SCJ reconstruction.

**CASE DESCRIPTION:** A 54-year-old female construction worker underwent SCJ reconstruction following a 5-year history of dysfunction. Physical therapy (PT) began 2 months postoperatively. PT consisted of a protective, intermediate, and strengthening phase. Interventions consisted of active and passive UE range of motion (ROM), isometric to resistive
strenthening, and manual therapy. PT frequency was twice a week for approximately 1 hour each session. Criteria for progression of phases included no complaints of pain with movement as well as UE ROM and strength measurements within functional limits.

OUTCOMES: Data were collected over 17 weeks of PT. Outcome measures included the Neck Disability Index (NDI), Disabilities of the Arm, Shoulder, and Hand Questionnaire (DASH), subjective pain, grip strength, and cervical and shoulder ROM. The DASH showed no significant changes, however the NDI scores declined and were clinically significant. Subjective pain, grip strength, and active ROM for the neck and right shoulder all improved.

DISCUSSION: SCJ dysfunction and reconstruction is uncommon. Interventions used to treat someone postsurgically are not widely available in the literature. This case report outlines a protocol for improving pain, grip strength, and ROM status-post SCJ reconstruction. Future research is needed to help develop a clinical protocol for the treatment of SCJ reconstruction.


Efficacy of a Computerized Knee Simulation Model on Developing Manual Therapy Skills in Physical Therapy Students

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PURPOSE/HYPOTHESIS: The purpose was to assess the effectiveness of training with a computerized joint simulation model on the acquisition, retention, and transfer of manual therapy skills. We hypothesized training on the computerized knee model would improve selected outcomes as an adjunct to classroom methods of manual therapy training, the experimental group would be more accurate in performing the forces of manual therapy techniques compared to a gold standard, the experimental group would have greater retention of the manual therapy skills, and skills acquired on the computerized knee model would be accurately transferred to the computerized shoulder model.

NUMBER OF SUBJECTS: Thirty-four first-year Doctor of Physical Therapy students.

MATERIALS/METHODS: Subjects were randomized into experimental and control groups. Both groups were pretested on a computerized knee model without feedback and with limited knowledge of mobilization techniques. Experimental group subjects attempted grade IV physiological flexion mobilizations on the knee model for 5 weeks. After 5 weeks of training, both groups were post tested on the knee model without feedback to assess efficacy of training. To assess transference, experimental group subjects attempted grade II anterior-posterior mobilizations on a computerized shoulder model. To assess retention and retention of transference, experimental group subjects performed mobilizations on both the knee and shoulder models 7 weeks later.

RESULTS: Wilcoxon signed-rank tests were performed comparing both groups pre to post tests, experimental and control post tests, experimental post test to retention, and experimental post test to transference for both accuracy and rate. Statistical significance was found in experimental and control post testing for accuracy (P = .002) and rate (P = .000), experimental pre to post testing for accuracy (P = .002), experimental post testing to transference for accuracy (P = .001), and control pre to post testing for rate (P = .002). Statistical significance was not found in experimental post testing to retention for accuracy and rate, experimental pretesting to posttesting for rate, experimental post testing to transference for rate, and control pre to post testing for accuracy.

CONCLUSIONS: These findings are consistent with 2 of the 4 proposed hypotheses. Results demonstrate that training on a computerized knee model would improve accuracy as an adjunct to classroom methods of training. However, rate was not affected. The experimental group was more accurate in performing the forces of manual therapy techniques compared to a gold standard. Further, the experimental group did not have greater retention of manual therapy skills, and skills acquired on the computerized knee model were not accurately transferred to the computerized shoulder model.

CLINICAL RELEVANCE: Results demonstrate the ERMI knee model would be a good adjunct to classroom methods of manual therapy training.


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BACKGROUND AND PURPOSE: Direct access physical therapy (PT) outcomes for lateral epicondylopathy (LE) have not been extensively reported. Cervical spine pain has been identified as a strong predictor for persistent LE symptoms, and LE is a common diagnosis seen in PT. There is a growing body of research to provide support for manual therapy targeted at the cervical spine for management of patients with LE; therefore, the purpose of this case report is to describe PT management for a patient with bilateral LE using manual therapy targeted at the cervical spine and elbow, along with activity modification interventions.

CASE DESCRIPTION: A 43-year-old man presents to direct access physical therapy for chronic bilateral elbow pain exacerbated with activity and associated history of cervical pain. Key physical examination finding included: (1) painful resist wrist extension (2) passive wrist flexion (3) limited humeral-ulnar joint mobility (4) painful and limited cervical active range of motion and (5) limited gross cervical and thoracic spine joint mobility. Initial clinical impression suggested bilateral LE with associated mid-cervical spine joint restrictions. Interventions consisted of manual therapy targeting the elbow, cervical and thoracic spine supplemented with activity modification and patient education to avoid symptom provoking activities. The patient was instructed on activity modification such as the benefits of wearing tennis elbow braces while exercising and using a wrist support while typing, and the patient purchased both with reports of decreased pain with activity while using these.

OUTCOMES: Outcomes were obtained at intake, discharge, and 15 weeks post discharge. Following 6 treatment sessions, clinically important improvements were seen with: pain intensity during activity (9/10 to 0/10), meeting the MCID when used with chronic pain; QuickDASH (42.5% to 4.5%); Patient-Specific Functional Scale (4/10 to 8/10), meeting the MCID of 1.2 points for upper extremity pain; and global rating of change score (“a very great deal better”). Global improvements in cervical active range of motion (ranging from 10° to 24°) and pain-free wrist extension were also observed. At a 15-week follow-up the patient demonstrated with 0/10 pain overall, 0% QuickDASH, and 10/10 Patient-Specific Functional Scale, with maintained cervical range of motion.

DISCUSSION: This case report demonstrates that interventions focusing on manual therapy at the elbow and cervical spine, along with activity modification, can lead to improvements in bilateral LE symptoms and neck pain/mobility. This case also demonstrates significant and sustained outcomes within a direct access treatment setting.

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**OP044**

COGNITIVE, NEUROLOGIC, AND PROCESSING CHALLENGES AND STRATEGIES AFTER HIP HEMI-ARTHROPLASTY OF AN ADULT WITH STURGE-WEBER SYNDROME

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**BACKGROUND AND PURPOSE:** Physical therapists commonly rehabilitate individuals after orthopaedic procedures including hip hemiarthroplasty. Occasionally, an individual presents with concurrent diagnoses that create unique challenges beyond the procedure. An example is a person with Sturge-Weber Syndrome (SWS) Type 1, which is a rare disorder associated with a facial cutaneous and intracranial vascular malformation with delays in motor and cognitive processing and neurologic impairments including hemiparesis and seizures. The purpose of this case report is to describe the postoperative physical therapy (PT) management of an adult with SWS after a hip hemiarthroplasty in a skilled nursing facility (SNF) with a discussion of the strategies used to address his unique challenges.

**CASE DESCRIPTION:** A 50-year-old man with SWS was admitted to a SNF following a posterior approach hip hemiarthroplasty for a proximal femoral fracture after a fall. Precautions included posterior hip precautions and weight bearing as tolerated. Prior to admission, he lived alone in a house in a small community and received case management support. Initial evaluation revealed distractibility, slow verbal and motor processing, low motivation, and pre-existing neurological weakness on the surgical side. Safety challenges included poor precaution adherence and risk of falls. Due to these findings, an atypical approach was employed for the patient’s postoperative PT. The environment was modified to improve adherence to precautions, and functional strengthening was prioritized over traditional resistive strengthening interventions. Maintenance of focus and participation required creativity. He was more willing to participate with interventions that reinforced his goal of increasing walking distance to socialize with friends rather than isolated muscle strengthening. Communication strategies of simplifying language and allowing extra time for response and movement resulted in increased patient engagement. The Performance Oriented Mobility Assessment (POMA) was chosen as an outcome measure because it reflected change without a timed component. Treatment was provided 5 times per week for 8 weeks.

**OUTCOMES:** He was discharged home at his prior level of function with no postsurgical complications or recurrence of falls. POMA score improved by 5 points. He met his walking distance goal, had minimal pain with movement, and demonstrated independent transfers.

**DISCUSSION:** Challenges during the patient’s rehabilitation required a treatment approach unique from common orthopaedic interventions after a hip procedure. Treatment prioritization emphasized efficiency, safety, and patient motivation. Working with individuals after orthopaedic surgery with cognitive, neurologic, and processing challenges, physical therapists across settings may need to creatively apply management strategies. Future research on physical therapy orthopaedic management in the presence of neurological challenges may further guide physical therapists working with similar patients.


**OP045**

EXAMINATION AND INTERVENTIONS FOR THE HIPS IN THE MANAGEMENT OF LOW BACK PAIN: A SURVEY OF PHYSICAL THERAPISTS

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**PURPOSE/HYPOTHESIS:** The purpose of this study was to determine the frequency that physical therapists examine and provide interventions directed at the hip(s) for individuals with a primary complaint of low back pain (LBP) and which hip tests/measurements and interventions are most commonly used.

**NUMBER OF SUBJECTS:** Nine hundred thirty respondents completed the electronic survey.

**MATERIALS/METHODS:** An electronic survey was emailed during January to April 2017 to members of the Orthopaedic and Sports Sections of the American Physical Therapy Association and members of American Academy of Orthopaedic Manual Physical Therapists. The survey underwent content expert review and pilot testing prior to distribution to target population. The final survey contained approximately 79 possible questions including demographic information and questions related to clinical practice patterns. Data are reported as means ± SD or proportions of respondents.

**RESULTS:** The response rate was estimated to be 15% based on project opening and click rates of the emailed survey. Respondents (n = 930; mean ± SD age, 40.5 ± 11.4 years; 48% male; 85% work in private or hospital outpatient) averaged 14.6 ± 11.6 years of experience as a physical therapist, and 33.2 ± 12.5 h/wk of direct patient care of which 40.7% ± 18.4% of their caseload is with patients with LBP. Approximately 64% reported they had a DPT degree, and 50% had OCS designation. Ninety-three percent (n = 866) of respondents report that they “most of the time or always” examine 1 or both hips for impairments in individuals with LBP. Respondents reported using the following tests/measures most frequently: muscle strength (90.6%, n = 843), passive range of motion (ROM) (97.3%, n = 812), muscle length (86.6%, n = 805), hip joint mobility (57.2%, n = 532) and soft tissue mobility (67%, n = 622). Respondents reported hip strengthening exercises (88.8%, n = 826) were prescribed most commonly followed by hip muscle flexibility (84.9%, n = 790), dynamic training (65.7%, n = 611), hip soft tissue mobilization (70%, n = 650), hip joint manual therapy (63.2%, n = 588), and modalities (17.8%, n = 166).

**CONCLUSIONS:** These findings suggest that physical therapists routinely examine and provide interventions targeting the hip(s) in individuals with a primary complaint of LBP. The most frequently cited examination
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Techniques were for testing hip strength, ROM and flexibility, whereas strengthening and stretching exercises were the most frequently prescribed types of hip interventions.

**Clinical Relevance:** The results of this survey provide insight into the current clinical practice patterns of physical therapists. The majority of respondents indicated that they typically examine and provide interventions directed at the hips for individuals with a primary complaint of low back pain.

**OP046**

**Electromyography Analysis of Shoulder Girdle Muscles During Cardinal Plane Arm Elevation at Different Body Positions**

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**Purpose/Hypothesis:** Exercise intensity is not well defined in shoulder rehabilitation protocols. Disparate activation of shoulder muscles can result in impaired biomechanics and muscle imbalances exacerbating pathology and delaying recovery. Plane of movement (POM) and body position (BP) can alter shoulder muscle activation and affect magnitude and direction of glenohumeral joint force. Therapeutic interventions can be customized to the desired intensity and rehabilitation goal by considering a patient’s BP and selecting specific POM. This study assessed the effect of POM and BP on shoulder muscle activation. We hypothesized that arm elevation demand on muscles will be affected by POM and BP in terms of peak activation and coincidental angle (arm elevation angle at peak activation).

**Number of Subjects:** Eighteen healthy, right-handed, male adults.

**Materials/Methods:** Subjects elevated their right arm in frontal and sagittal planes from 0° to 120° in seated, sidelying, prone, and supine positions. Arm motion was monitored using 3-D motion capture. Demand on muscles was assessed as a percentage of manual muscle testing (percent MMT) using peak activation and coincidental angle. Surface EMG electrodes were placed on: posterior (PD), middle (MD), and anterior deltoid (AD), upper trapezius (UT), pectoralis major, biceps brachii, triceps brachii, and latissimus dorsi muscles. A 2-way (POM by BP) repeated-measures ANOVA design was used to test for significant differences (α = .05).

**Results:** Significant 2-way interactions (P < .05) were observed in peak EMG activation and coincidental angle elevation for all muscles. Only the UT and the deltoids showed significant EMG activation levels (greater than 20% MMT). Significant POM main effects were observed in EMG activation for the UT, MD and PD, with higher activation for the frontal plane (P < .05) for all positions. We did observe significant BP main effects in EMG activation for all muscles. Prone and seated positions imposed higher demands (P < .05) than sidelying and supine. Regardless of POM the EMG activation of all muscles remained well below 40% MMT for the sidelying and supine positions (except AD, 40%). The coincidental angle was at (or close to) 90° in the seated and prone positions for the UT and the deltoids, regardless of the POM. The coincidental angle for the sagittal POM was significantly earlier (at approximately 30° of elevation) than the frontal in the supine and sidelying positions.

**Conclusions:** Muscle peak activation is dependent on the POM and BP in which it is completed. Frontal and sagittal plane shoulder elevation places differing demands on muscles.

**Clinical Relevance:** Selection of optimal rehabilitation exercises is critical to patient prognosis and recovery. Identifying exercises that target specific muscles and modulate glenohumeral joint force is essential to meeting the rehabilitation goals for a patient.

**OP047**

**Acute Exertional Rhabdomyolysis in a Patient Referred to a Physical Therapist for Thoracic Back Pain: A Case Report**

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**Background and Purpose:** It is important for physical therapists to be highly efficient in recognizing signs and symptoms of potentially serious medical conditions that can mimic musculoskeletal dysfunction and appropriately refer to another health care practitioner when indicated. The purpose of this report is to describe the clinical decision making process for a patient diagnosed with acute exertional rhabdomyolysis (AER) after being referred to a physical therapist for the treatment of pain in the thoracic spine.

**Case Description:** The patient was a 25-year-old woman who was referred to a physical therapist for the treatment of pain in the thoracic spine by her primary care physician, who had seen earlier that day. The patient’s chief complaint was a 3-day history of constant, severe, and diffuse pain in the periscapular and thoracic spine regions with secondary complaints of pain in her neck and both of her arms. Symptom onset coincided with vigorously performing a new exercise routine which involved intense progressive weight training and aerobic activity. The patient denied numbness or tingling in her upper or lower extremities, bowel or bladder problems (including changes in urinary color or frequency), shortness of breath, fevers, fatigue, or changes in weight. No diagnostic imaging had been performed and her past medical history was otherwise unremarkable. While the patient was not willing to perform any movement of the cervical or thoracic spine due to pain and apprehension, bilateral active shoulder flexion was limited to 60° and caused an increase in pain in the mid-thoracic spine. There was exquisite tenderness to palpation in the periscapular and thoracic spine regions.

**Outcomes:** Due to concern over AER, the patient was again questioned regarding any changes in urinary color; she again denied any changes. However, the patient’s friend, who accompanied her to the visit, reminded her that her urine had been “iced tea” color the past 2 days, which she attributed to being dehydrated. Given these findings, the patient was immediately referred to her physician. The patient was admitted to the hospital where she was diagnosed with AER based on creatine kinase levels that peaked at 55 000 U/L (normal range, 38-176 U/L) and significant myoglobinuria. The patient was hospitalized for 4 days for rehydration with intravenous fluids and rest. The patient recovered without complications and eventually returned to her exercise routine under the close supervision of the physical therapist.

**Discussion:** Physical therapists should be aware that AER may adversely affect individuals who participate in novel and intense activities to which they are unaccustomed. This patient case underscores the importance of recognizing signs and symptoms of serious disease that can potentially mimic musculoskeletal dysfunction, and appropriately referring to another health care practitioner in a timely fashion when indicated.

**References:**

**OP048**

**Acute Calcific Tendinitis of the Rectus Femoris Managed with Multimodal Physical Therapy**

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**Background and Purpose:** Calcific tendinitis of the rectus femoris is a relatively rare condition and little has been published in the literature regarding optimal nonoperative management. Published recommended nonop-
erative management approaches for calcific tendinitis include activity modification, anti-inflammatory medication, injections, gentle exercise, and modalities, though efficacy of nonoperative management for this condition is not known. In recalcitrant cases, surgical excision is recommended. This case report describes successful physical therapy management of a patient with acute rectus femoris calcific tendinitis.

**CASE DESCRIPTION:** A 33-year-old nurse was referred to physical therapy with a 3 week history of insidious onset sharp left anterior/lateral hip pain rated 9/10 at worst, 4/10 at best that occasionally radiated to the groin and was gradually worsening. Intake outcome measures showed a Lower Extremity Functional Scale (LEFS) of 32/80 and Patient-Specific Functional Scale (PSFS) of 4/10 for walking, and 6/10 playing with her toddler. Aggravating factors included walking, climbing/descending stairs, and work and home activities. Lying supine with her leg elevated was the only position that provided symptom relief. Physical exam showed a cautious gait pattern with pain reproduced during left leg terminal stance, limited left hip extension and flexion, positive left FABER position, hip capsular tightness, and impaired muscle performance of the left hip flexors, abductors, and knee extensors limited by pain. Hip radiographs showed calcification in the reflected head of the left rectus femoris. Initial physical therapy intervention consisted of education about activity modification, gentle hip flexor and rectus femoris stretching, and application of iontophoresis to left rectus femoris tendon using acetic acid, which the patient continued at home for 5 applications every other day.

**OUTCOMES:** At the second physical therapy visit 1 week later, patient noted significant decreases of pain, rated 0/10, improved LEFS 68/80, and PSFS 10/10 walking, 10/10 playing with her toddler. The second and third physical therapy visits included hip mobilizations to improve hip range of motion, hip active range of motion, and functional hip strengthening to improve muscle performance around the hip. Improvements in all outcome measures were seen at the third and final visit 2 weeks later with global rating of change rated +7, LEFS at 77/80 and the patient returned to full activity. The patient remained asymptomatic in the left hip at 1-year follow-up.

**DISCUSSION:** This case patient shows successful physical therapy management of acute calcific tendinitis of the rectus femoris. Early utilization of iontophoresis with acetic acid and activity modification inspired initial pain and function and allowed multimodal interventions of exercise and manual therapy to be implemented to improve remaining functional limitations. Early physical therapy allowed this patient to return to work and full activity without injections or surgical intervention.


### OP049

**STEP WIDTH AFFECTS HIP CONTACT FORCES DURING RUNNING**

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**PURPOSE/HYPOTHESIS:** Hip pain is common in runners and is thought to be related, in part, to aberrant hip joint loads. Alterations in step width (SW) during running may affect hip contact forces (HCF). An increase in SW has previously been shown to reduce HCF during walking; however, the effect of adopting a wider SW during running on HCF has not yet been investigated. Our hypotheses were 2-fold: (1) runners who demonstrate a narrow SW will exhibit higher HCF; (2) adopting a wider SW during running will effectively reduce HCF.

**MATERIALS/METHODS:** Baseline running mechanics were collected at a self-selected speed (2.9 ± 0.2 m/s) on an instrumented treadmill using 3-D motion capture. Running gait was then modified from baseline using real time visual feedback to cue a 5% of leg length increase in SW. SW was calculated as the frontal plane distance between L5/S1 and ankle joint. After acclimation, a 15-second trial was sampled for each condition. A musculoskeletal model was used to calculate HCF over 10 stance phases. Peak and integral of the resultant HCF over stance (impulse) were extracted. Participants were categorized into groups of runners with narrow SW and those with a wider SW using the inflection point of a polynomial curve fit to participants’ minimum baseline SW. The effects of widening SW on HCF were compared between runners with narrow SW and those with a wider SW using a mixed model ANOVA (η² ± ±.05). Effect size was quantified with eta-square (0.01-0.05, small; 0.06-0.13, medium; greater than 0.14, large). SW, step length and hip dynamics were also examined.

**RESULTS:** At baseline, peak HCF was 1.2 ± .55 BW greater in narrow-based runners: (SW: n = 19, 14 female) when compared to wider-based runners (n = 13, 5 female) (P = .03, η² = .18). Participants increased their SW on average by 5.1 ± 2.1 cm with real-time feedback (P = .01, η² = .86). Across both groups, peak HCF was 0.43 ± .12 BW lower with cues to increase SW (P = .002, η² = .28). 25/32 runners demonstrated reduced peak HCF with the cue to widen SW. HCF impulse did not differ between groups or conditions (P > .05). With feedback for a wider base, runners demonstrated a concomitant 4% shorter stride length (P < .01, η² = .56). The predominant motor strategy to increase SW also consisted of reduced contralateral pelvic drop, peak hip adduction and internal rotation, and peak internal hip flexion moment (P < .01, η² = .40-0.83).

**CONCLUSIONS:** Individuals with narrow SW displayed markedly greater HCF potentially predisposing them to injury. Regardless of preferred SW, feedback to widen base of gait during running reduced peak HCF. Shortening stride length has also been reported to lower HCF. The shortened stride length that accompanied the wide SW gait modification may have partially contributed to the reduced HCF’s that were observed in this study.

**CLINICAL RELEVANCE:** Modifying SW during running may benefit runners with hip pain. Future work should assess the effects of adopting a wider SW on pain in a running population with hip pathology.

### OP050

**A QUALITY ASSESSMENT OF LUMBAR MANIPULATION TECHNIQUES ON YOUTUBE: A SYSTEMATIC REVIEW OF VIDEO CONTENT**

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**PURPOSE/HYPOTHESIS:** Youtube is a popular non-peer-reviewed source of free information, often used by patients and early career professionals alike, to gain information on presumptive diagnosis and techniques online.13 Patients are increasingly doing their research on the internet either before attending a health care provider or after an initial consultation.14 However, the lack of regulation on educational content available on YouTube leaves it open to the possibility containing misguided or simply not helpful information. This may have a profound effect on the patient-health care provider relationship,14 and since sources such as YouTube may play a role in patient’s decision-making process, physical therapists should be cognizant of the quality of the content. Therefore, this study was carried out to assess the quality of information available on YouTube regarding lumbar manipulation techniques.

**NUMBER OF SUBJECTS:** Seven reviewers.

**MATERIALS/METHODS:** YouTube was searched in March 2017 for videos demonstrating lumbar manipulation using the phrases “lumbar manip-
ulation” and “side-lying lumbar manipulation.” We limited our search to the first page for each of the phrases due to the assumption that PT students and early career professionals looking to re-learn lumbar manipulation would rarely venture beyond the first page (containing 20 videos) before settling on a video resource. The English language was a prerequisite for the inclusion. After filtering 42,880 videos through predetermined selection criteria, 21 videos were identified for analysis. Three student physical therapists (final year DPT program) and 4 clinicians independently reviewed and scored all of the videos on 12 characteristics with the novel rubric - Manipulation Education Tool (MET), with a maximum score of 18 points. Videos were grouped according to quality assessment score, and the group means were analyzed for differences in video characteristics. Videos were graded based on their score on an 18-point scale: 18 to 16 is excellent, 13 to 15 is good, 10 to 12 is fair, 7 to 9 is poor, 6 or below is very poor.

RESULTS: The average point total for all the videos graded by all 7 graders was 12.075 or a rating of a fair (out of a possible score of 18). The average point total for all 4 clinician raters was 13.54 or a rating of Good, while the average point total for the 3 student raters was 10.13 or a rating of Fair. One video was rated as Excellent, 7 as Good, 7 as Fair, 5 as Poor, and 0 as Very Poor. The source of most of the videos was educational (67%), and most of these included therapists (66%).

CONCLUSIONS: Patients and physical therapists searching YouTube for videos pertaining to lumbar mobilization will be presented with a sizeable repository of content of overall low quality or misleading information. Based on this review, YouTube cannot be considered a viable source to educate physical therapists on lumbar manipulation techniques.

CLINICAL RELEVANCE: This review highlights the need to develop evidence-based, comprehensive educational videos addressing lumbar manipulation techniques.

OP051

EFFECTIVENESS OF MOVEMENT RETRAINING IN A SERVICE MEMBER WITH CHRONIC KNEE PAIN

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BACKGROUND AND PURPOSE: In the US Army, acute knee musculoskeletal injuries are associated with increased rates of medical discharge. Furthermore, higher loading rates observed in rearfoot strike running has been associated with lower extremity injury, with knee involvement accounting for 42% of overuse injury. Retraining running mechanics via faded biofeedback has been shown to improve pain and function, but has yet to see widespread application in the military. The purpose of this case report is to describe outcomes of a service member who underwent movement retraining, focused on strike pattern, for running-associated chronic knee pain.

CASE DESCRIPTION: The patient was a 20-year-old man, active-duty US Marine Corps, presenting with bilateral knee pain during running in running shoes and military boots, beginning in 2014 during basic training. In 2016, the patient was referred to the Movement Retraining Clinic at the Naval Medical Center San Diego. Whole-body mechanics were measured during treadmill running (2.70 m/s), using optical motion capture and an instrumented treadmill. Results from the initial analysis (PRE) revealed bilateral heelstrike in both boots and shoes, with elevated knee energy absorption relative to the hips and ankles. Over 9 sessions in 3 weeks, the patient received real-time visual feedback during running in shoes for foot inclination angle targeting a midfoot strike. Running mechanics were reassessed in shoes and boots post training (POST) and at 1-month follow-up (FU).

OUTCOMES: The following outcomes were compared: foot strike index (SI; 0% is heel strike, 100% is toe strike), ground reaction load rate (GLR, bodyweights/second (BW/s) ), knee joint energy absorption as a proportion of total leg energy (KnABS), Lower Extremity Functional Scale (LEFS), and knee pain. Biomechanical analysis showed SI, GLR, and KnABS were nearly symmetrical between limbs in boots and shoes across visits, thus only right-referenced data are presented here. Measurement confirmed patient achieved a midfoot strike at POST (SI of 48% shoes, 53% boots), that was maintained at FU (SI 60% shoes, 57% boots), compared to a heelstrike at PRE (SI 9% shoes, 2% boots). Subjectively, the patient reported decreased knee pain from 7/10 PRE, to 0/10 POST and FU when running in shoes. LEFS improved from 57 points PRE, to 62 points POST, and 66 points at FU. KnABS decreased in shoes (boots) from 71% ± 75% at PRE, to 65% ± 47% at POST, and 45% ± 42% at FU. GLR was reduced from 55 ± 52 BW/s at PRE, to 36 ± 34 BW/s at POST and 40 ± 32 BW/s at FU.

DISCUSSION: Successful outcomes were demonstrated for this service member with running-associated knee pain up to 1-month following movement retraining. Notably, retraining was performed in running shoes with carry-over of the strategy to running in military boots. Lastly, a shift in mechanical demand from structures at the knees, to those at the ankles appeared associated with the change in foot strike. Therefore, a gradual transition with a supplemental home exercise program is recommended to avoid calf and Achilles tendon injuries.


OP052

MUSCLE STRENGTH 10 YEARS AFTER TOTAL HIP ARTHROPLASTY: COMPARISON WITH HEALTHY INDIVIDUALS: CONTROLLED CROSS-SECTIONAL STUDY

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PURPOSE/HYPOTHESIS: Total hip arthroplasty (THA) has been used to treat numerous hip joint pathologies. However, this surgical approach initially brings important deficits in articular range of motion, functional patterns and muscle strength. Studies that evaluated short-term muscle capacity showed that abductors, extensors and lateral hip rotators are the most affected group, but long-term functional reports of these kind of patients are limited in the literature. Therefore, we investigated the hypothesis that individuals who underwent total hip arthroplasty after 10 years present decreased muscle strength in the main stabilizing muscles of this joint. This hypothesis was investigated through analysis of hip muscle strength in patients who underwent surgery 10 years ago compared to healthy individuals.

NUMBER OF SUBJECTS: Twenty-five.

MATERIALS/METHODS: Twenty-five subjects of both sexes, aged 62 ± 7 years, were evaluated, 10 healthy subjects and 15 subjects submitted by the same medical group to unilateral total hip arthroplasty (Exceter) 10 years ago through the posterolateral approach. Patients underwent a clinical evaluation and performed muscle strength analysis by a single blinded evaluator responsible for maximum isometric analysis by a hand-held dynamome-
HIp MUSCLE STRENGTH AND TIBIOFEMORAL AND PATELLOFEMORAL CARTILAGE DAMAGE WORSENING IN PERSONS WITH KNEe OSTEOARTHRITIS

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PURPOSE/HYPOTHESIS: Persons with knee OA exhibit diminished hip muscle strength; targeted hip strengthening exercises have been shown to ease pain and improve function in individuals with medial tibiofemoral (TF) OA. Persons with patellofemoral (PF) pain also show weak hip abductors and external rotators. Informed by these findings, current conservative management includes hip strengthening for patients with knee OA and those with PF pain. Yet, whether greater hip muscle strength protects against OA disease progression in the TF or PF compartments is unknown. We hypothesized that greater baseline hip strength is associated with a reduced risk of TF and PF cartilage damage worsening over the next 2 years in persons with knee OA.

NUMBER OF SUBJECTS: One hundred sixty-four.

MATERIALS/METHODS: Participants all had knee OA (K/L grade greater than 2) in at least 1 knee. Bilateral isometric strength of hip abductors and external rotators were measured at baseline, using a Biodex Dynamometer; we analyzed the average peak torque from 3 trials. Participants underwent 3.0-T MRI of both knees at baseline and 2 years later using double oblique coronal and axial turbo SE sequences. Baseline-to-2-year cartilage damage progression, defined as any worsening of WOMAC (Whole Organ Magnetic Resonance Imaging Score), was assessed in each articular surface: any TF, medial TF, lateral TF, any PF, medial PF, and lateral PF. Knees graded K/L 4 or with severe PF joint space narrowing at baseline were excluded. We analyzed associations between baseline body weight normalized hip strength and cartilage damage worsening, using logistic regression with generalized estimating equations, adjusting for age, sex, and WOMAC pain.

RESULTS: The sample consisted of 275 knees from 164 persons: mean ± SD age, 63.7 ± 9.8 years; BMI, 28.0 ± 5.3 kg/m²; 130 (79.3%) women. The mean ± SD hip abductor strength was 0.84 ± 0.24 Nm/kg; hip external rotator strength was 0.61 ± 0.13 Nm/kg. As shown in Table 1, greater baseline hip abductor strength, but not hip external rotator strength, was significantly associated with a reduced likelihood of medial PF cartilage damage worsening 2 years later. For every 0.1 Nm/kg increase in hip abductor strength, there was a 22% reduction in the adjusted odds of medial PF disease worsening. Although not statistically significant, the adjusted OR was in the protective range (ie, OR<1.0 in all instances), with P<.10 for hip abductor strength and lateral TF cartilage damage worsening.

CONCLUSIONS: In persons with knee OA, stronger baseline hip abductors may help protect against knee OA disease progression, particularly in the medial PF compartment. Future studies with longer follow-up and in a larger sample may further elucidate the role of hip strength in protecting against cartilage deterioration.

CLINICAL RELEVANCE: Our findings demonstrate the protective effects of hip strength on structural worsening in persons with knee OA, underscoring the important role of hip muscles in preserving cartilage health.

OP053
appear to be significant overall. In weaker individuals, greater laxity trended towards an association with less severe perceived instability.

**CLINICAL RELEVANCE:** Higher knee extension strength may be able to compensate for higher varus-valgus laxity and reduced perceived instability; however, future research is needed to determine if increasing knee extension strength improves perceived instability.

**OP055**

**SINGLE-LEG LOADING ASSESSMENT TOOL: INTERRATER AND INTRARATER RELIABILITY USING A QUANTITATIVE MEASUREMENT TOOL TO ASSESS THE QUALITATIVE MECHANICS OF A TRIPLE HOP**

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**PURPOSE/HYPOTHESIS:** To examine the inter and intrarater reliability of the Single Leg Loading Assessment Tool (SLLAT) as a means of assessing the quality of movement of athletes. The study hypothesized that the inter and intrarater reliability would be moderate to high.

**NUMBER OF SUBJECTS:** Sixty physical therapists.

**MATERIALS/METHODS:** A male athlete was recorded performing the triple hop component of the Hop Test. Two simultaneous videos were recorded (lateral/front views) via 2 Apple iPads. Apple iMovie was used to format the videos to allow simultaneous viewing of both angles. Subjects were emailed the SLLAT with definitions of each category being assessed and asked to watch the video and grade it using the SLLAT. After 1 month, subjects were asked to re-watch and grade the same video without viewing previous results.

**RESULTS:** A Bland-Altman plot was initially conducted to assess the level of agreement between administrations of the SLLAT and suggested that good consistency existed between administrations ($r = 0.71$). Spearman’s Rho analysis was used to determine whether a significant relationship existed between the 2 separate administrations of the tool and demonstrated a strong positive statistical relationship amongst the 2 separate testing administrations ($r = 0.77, n = 51, P < .05$). Intratester reliability analysis demonstrated a significantly high ICC of 0.997 with a 95% confidence interval from 0.993 to 0.999 ($F = 376.16, P < .05$) for the first administration and an ICC of 0.996 with a 95% confidence interval from 0.993 to 0.999 ($F = 318.76, P < .05$) for the second administration. A Cronbach’s alpha analysis was used to demonstrate the level of internal consistency of the 13 individual items in the SLLAT and revealed that an acceptable level of consistency was present during the first administration ($r = 0.71$) and a questionable level of consistency for the second administration ($r = 0.66$). Both could have been improved if select sections of the SLLAT were taken out.

**CONCLUSIONS:** There was a strong positive relationship both between and amongst test administrations. These results support the research hypothesis and demonstrate moderate to high intra and intertester reliability of the SLLAT. Though statistically, the study demonstrated a strong positive correlation with the intrarater and interrater reliability, internal consistency could have been enhanced if certain sections in the SLLAT were eliminated.

**CLINICAL RELEVANCE:** Knee injuries occur frequently throughout the year in all populations especially in the youth and adult athletes.24 Having a quick and reliable quantitative assessment tool examining the quality of loading mechanics is pivotal for return to sports and is lacking in current literature. This study demonstrated statistical significance, which substantiate its reliability as a quick quantitative assessment tool that can eventually be used in the clinic as a potential predictive tool for future knee injuries.

**OP056**

**MANAGEMENT OF CONCUSSION WITH CERVICAL SPINE IMPAIRMENTS: A CASE STUDY**

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**BACKGROUND AND PURPOSE:** Cervical spine pain is not a common complaint after a concussion, but deficits in motion and strength are commonly seen. The purpose of this case report is to describe the management of a patient after a concussion with a clear element of axial loading of the cervical spine. This case will highlight the importance of evaluation and treatment of both the upper and lower cervical spine regions.

**CASE DESCRIPTION:** The patient is an 18-year-old female soldier who sustained a concussion when a 60-lb sand bag fell onto her head. She received PT interventions with a bias on the cardiovascular system for 3 weeks while she continued her daily training. Her symptoms worsened which prompted her to be released for a 30-day rest period. While on medical leave she was evaluated by our concussion center. She was referred to PT for the following symptoms: headache, light/noise sensitivity, visual disturbances, tinnitus, dizziness, concentration deficits, fatigue, nausea and emotional lability. PT exam revealed upper cervical hypomobility at C0-1, C1-2, significant cervical and temporomandibular soft tissue tenderness, lower cervical derangement with upper extremity myotomal weakness, and poor posture awareness/endurance cervical spine impairments. Outcome measures were collected focusing on graded symptom checklist, dizziness, headache and neck disability as well as balance and reaction time. Normalizing the upper and lower cervical biomechanics via manual interventions and repeated exercises was the primary goal. Other important components to her treatment included concussion symptom education, ergonomics (phone and computer), temporomandibular resting position and posture correction.

**OUTCOMES:** After 3 PT sessions DHI, HDI and NDI, cervical spine mobility/strength improved significantly while BESS balance testing, reaction times, also improved. Her initial impairments of daily living were resolved and she returned to basic training.

**DISCUSSION:** It is imperative that physical therapists understand how the cervical spine and vestibular systems complement each other to manifest symptoms after a concussion. A thorough cervical spine evaluation after a concussion should be performed regardless of mechanism of injury. In this case the cervical spine was the key to unlock the patients overall symptoms and allow her to return to training.

Combined Sections Meeting

Patient population. The purpose of this study was to determine if patients with and without diabetes differed in the recovery of 3 physical performance measures over the first 90 days following a TKA.

**NUMBER OF SUBJECTS:** One hundred sixty-nine.

**MATERIALS/METHODS:** Data collected at ATI Physical Therapy from 169 patients (37 with diabetes, 132 without) were available. Patients received a unilateral TKA between 2013 and 2015 and had at least 3 postoperative visits, a record of when the visit occurred as measured by days since surgery, and a record of the presence of diabetes or not. Physical performance measures included the 4-meter walk (4 mW) test, the 30-second sit-to-stand test (30STS), and the timed-up-and-go test (TUG). A mixed effects model was performed, regressing the outcome of interest (ie, 4mW, 30STS, TUG) on fixed effects of time from surgery (in postoperative days) and group designation (“with DM” versus “without DM”). The significance of the group variable, as well as the interaction of group by time, was used to test whether groups differed in postoperative recovery.

**RESULTS:** Both groups had similar baseline values for all measures. While both groups showed improvement over the 90 postoperative days, patients with DM demonstrated both slower rates of recovery in 4mW gait speed (P = .009) and 30STS (P = .033), and worse scores for all outcome measures at the end of 90 days (4mW, P = .001; 30STS, P = .031; TUG, P = .005). For all 3 measures, the differences between groups at the end of 90 days exceeded the minimal clinically important differences reported in previous literature.

**CONCLUSIONS:** Patients with DM demonstrate a slower rate and lower level of recovery in all physical performance measures over the first 90 postoperative days after TKA, compared to patients without DM. These measures provide objective assessments of functional deficits after surgery, and are helpful in appreciating the complexity of patient recovery after TKA.

**CLINICAL RELEVANCE:** Clinicians should closely monitor and appropriately treat patients with diabetes, knowing that they are at higher risk for sustained functional deficits. The results of this study provide a rationale for future studies investigating the development of targeted interventions specific to patients with diabetes, which can guide clinicians on alternative rehabilitation approaches that may be better suited to address the needs of this understudied patient subgroup.

**OP058**

**DEMOGRAPHICS, COMORBID CONDITIONS, AND MEDICATIONS AMONG ADULTS SEEKING PHYSICAL THERAPY SERVICES FOR SPINE-RELATED PAIN**

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**PURPOSE/HYPOTHESIS:** The purpose of this study was to describe the demographic, health, and medical characteristics of adults who had 1 or more visits with a physical therapist for spine-related pain.

**NUMBER OF SUBJECTS:** The 2012-2014 Medical Expenditure Panel Survey data files contained 59,840 unweighted cases from which we identified 578 adult cases that had a physical therapy visit for spine-related pain.

**MATERIALS/METHODS:** This study used data from 3 panels of the Medical Expenditure Panel Survey (MEPS) encompassing the years of 2011 to 2014. The MEPS is a nationwide survey conducted by the Agency for Health Care Research and Quality that provides detailed population-level information about health care utilization and costs in the United States. Data from the MEPS can be weighted to represent the entire U.S. population. MEPS variables that characterized adults who had a physical therapy workforce visit in terms of demographic characteristics, perceived health status, comorbidities, and medication use were employed for this analysis.

**RESULTS:** During the study period of 6.76 million adults sought care from a physical therapist for spine-related pain. Of these, 60.2% (95% CI: 55.3%, 65.2%) were female, 79.5% (95% CI: 75.7%, 83.3%) were white with an average age of 54.1 (95% CI: 52.7, 55.5) years. Most common comorbid conditions were arthritis (37.6%; 95% CI: 52.8%, 62.5%), high cholesterol (44.6%; 95% CI: 39.2%, 50.0%) and high blood pressure (41.4%; 95% CI: 36.8%, 45.9%). Perceived health was classified as good to excellent among 71.7% (95% CI: 67.6%, 75.8%) of the respondents. Similarly, perceived mental health status was classified as good to excellent among 76.2% (95% CI: 72.2%, 80.3%) of the respondents. The medications that these adults were most commonly using included narcotic analgesics (39.9%; 95% CI: 35.0%, 44.8%), antihyperlipidemics (29.6%; 95% CI: 24.6%, 34.6%), antidepressants (27.5%; 95% CI: 23.15%, 32.0%), muscle relaxants (25.5%; 95% CI: 21.0%, 30.15) and anticonvulsants (24.9%; 95% CI: 20.55%, 29.3%).

**CONCLUSIONS:** A majority of adults with spine-related pain who seek care from a physical therapist are white, female, and report good to excellent health status. Aside from their spine pain, these individuals often have comorbidities such as arthritis. Many have cardiovascular risk factors such as high cholesterol or high blood pressure. Use of narcotic analgesics and other central nervous system agents is common within this population.

**CLINICAL RELEVANCE:** Physical therapists who are treating patients with spine-related pain need to understand the prevalence of comorbidities and cardiovascular risk factors in order to provide safe and effective interventions. The cardiovascular risk factors are of particular note since physical therapists are in an optimal position to provide interventions and education related to these issues. In addition, educational programs in physical therapy will want to ensure that musculoskeletal coursework incorporates content in pharmacology, including agents that act on the central nervous system.

**OP059**

**PREOPERATIVE ACTIVITY LEVEL AND BODY MASS INDEX INFLUENCE 1-YEAR DISABILITY SCORES FOLLOWING HIP ARTHROSCOPY**

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**PURPOSE/HYPOTHESIS:** The purpose of this study was to evaluate relationships between preoperative age, gender, body mass index (BMI), activity level, location of symptoms and duration of symptoms on disability outcomes 1 year (mean ± SD, 16.0 ± 3.2 months) following hip arthroscopy for femoral acetabular impingement. We hypothesized that patients that were older, female, sedentary, reporting primarily extra-articular hip pain and had longer-term duration of symptoms would report worse disability scores following surgery.

**NUMBER OF SUBJECTS:** Three hundred six (mean ± SD age, 32.6 ± 10.5 years; BMI, 25.8 ± 5.7 kg/m²; 40% male).

**MATERIALS/METHODS:** Retrospective cohort design with 1 board-certified orthopaedic surgeon and outpatient rehabilitation team within Intermountain Health care was conducted. Initial and 1-year Short Version of the International Hip Outcome Tool (iHOT-12) scores were used to compute change scores prior to the main analyses. Age was categorized into the following groups: less than 30 (n = 113), 30 to 40 (n = 110), greater than 40 (n = 83). BMI was categorized into the following groups: underweight (less than 18.5 kg/m², n = 19), ideal weight (18.5-24.9 kg/m², n = 137), overweight (25.0-29.9 kg/m², n = 83), obese (greater than 30 kg/m², n = 67). Tegner Activity Level Scale was categorized based on the following groups: sedentary (less than 4, n = 49), active (5-7, n = 181), highly active (greater than 8, n = 76). Duration of symptoms was categorized based on the following groups: short-term (12 months or less, n = 120), mid-term (12-36 months, n = 90), long-term (greater than 36 months, n = 96). Multivariable linear regression modeling was used to examine the influence each demographic predictor variable had on iHOT-12 change scores following surgery.

**RESULTS:** Patients preoperatively classified as being highly active (mean difference [MD], 13.7; 95% CI: 0.4; 26.9; P = .04) and obese (MD, 9.9; 95% CI: 0.5, 19.3; P = .04) relative to sedentary and ideal body weight, reported significantly greater improvement on iHOT change scores. No other predictor variables had any influence on iHOT change scores.

**CONCLUSIONS:** Patients reporting higher activity level and higher body
Combined Sections Meeting

A total of 4796 from the Osteoarthritis Initiative -

mass index prior to surgery demonstrate larger improvements in iHOT change scores at 1 year following surgery. Alternative clinical factors did not appear to have a significant influence on iHOT change scores.

Clinical Relevance: Hip arthroscopy is a growing surgical procedure for a variety of patient populations. Identifying clinical risk factors that can influence 1-year disability scores is understood. Inability to set appropriate postoperative expectations may lead to perception of an unsuccessful recovery and potentially lower clinical outcome scores. Preliminary findings indicate preoperative factors of perceived activity level and body mass have a significant influence on disability changes scores at 1 year following surgery. These findings may provide an opportunity to improve education to patients when setting postoperative expectations. Incorporating preoperative rehabilitation and/or consultation programs may also be an effective treatment strategy to improve on long-term disability scores postoperatively.

op060

Is a Growing Waistline Over 8 Years Associated with Incident Functional Limitation and Low Health-Related Quality of Life in Knee Osteoarthritis?

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Purpose/Hypothesis: A large waist circumference (WC) is associated with walking difficulty in people with or at risk for knee osteoarthritis (OA). Today, it is unclear whether a meaningful increase in WC is also associated with walking difficulty and poor health. This is important to study since minimizing gains in WC may be important to reduce functional limitation and low health-related quality of life (HRQoL), which are common in knee OA. The purpose of this study was to investigate the association of increasing WC with function and HRQoL in people with or at risk for knee OA.

Number of Subjects: A total of 4796 from the Osteoarthritis Initiative (OAI).

Materials/Methods: Data were extracted from the OAI, a large prospective cohort study of people with or at risk for knee OA. Our primary exposures of interest were baseline WC and a meaningful increase in WC. WC was measured around the participant’s mid torso at the largest circumference with a tape measure. Baseline WC was classified into 2 groups using established thresholds: (1) Large WC (males greater than 102 cm, females greater than 88 cm) and (2) Small WC (males, 102 cm or less; females, 88 cm or less). A meaningful increase in WC over an 8-year time frame was classified into 2 groups: (1) Increase (greater than 5 cm) and (2) Maintain (5 cm or less). Our 2 outcome measures of interest were function and HRQoL in people with or at risk for knee OA.

Results:

- At baseline, 2338 people were free of baseline WC, 2534 had a meaningful increase in WC, and 924 had a maintained WC.
- Among people with baseline WC, the Large WC group had 1.7 (95% CI: 1.3, 2.2) times the risk of developing functional limitation and 1.7 (95% CI: 1.3, 2.3) times the risk of a poor HRQoL compared with the Small WC group. Those in the Large WC-Maintain group had 1.7 (95% CI: 1.3, 2.2) times the risk of developing a functional limitation compared with the Small WC-Maintain group, but were at similar risk for poor HRQoL: RR = 1.1 (95% CI: 0.8, 1.4). Participants in the Small WC-Increase group were at similar risk as the Small WC-Maintain group for developing functional limitation: RR = 1.2 (95% CI: 0.9, 1.7) and poor HRQoL: RR = 1.0 (95% CI: 0.7, 1.5).

Conclusions:

- People with large WC had greater risk of functional limitation and poor HRQoL 8 years later, irrespective of increasing WC, compared with those with a small WC. Those with a large WC who increase WC had the highest risk compared to those with a small WC who maintained WC.

Clinical Relevance: Educating people with knee OA to avoid WC gains, particularly those already with a large WC, may mitigate future functional limitation and poor HRQoL.

op061

Proximal Plantar Intrinsic Tendinopathy: A New Differential Diagnosis for Plantar Heel Pain

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Background and Purpose: Plantar heel pain is the most prevalent (11%-15%) complaint amongst patients seeking services from foot/ankle specialists. Based on the proximal attachments of flexor digitorum brevis (FDB), abductor hallucis (AH), and the medial head of quadratus plantae (QP) at the medial calcaneal tubercle, these muscles are subjected to mechanical stresses similar to the plantar fascia. Similar to the plantar fascia, these muscles function collectively to resist depression of the mediolateral longitudinal arch during weight bearing. While numerous etiologies of plantar heel pain exist, mechanical abnormality is the most common. Repetitive and overuse injuries are the major etiology of tendinopathies, which, in this case, coincides with the repetitive cyclic loading of these plantar intrinsic muscles during gait and weight bearing activities. With injury, tendon repair is often prolonged secondary to low cellularity and poor vascular supply especially if potential tendinopathic changes are not specifically addressed. Therefore, the proximal tendinous origin of these intrinsic muscles should be considered as a differential diagnosis in the presence of chronic plantar heel pain.

Case Description: A 52-year-old man with a past medical history of small fiber neuropathy affecting bilateral distal lower extremities and a 13-year history of bilateral chronic plantar fasciosis received a surgical release of his left plantar fascia due to intractable plantar heel pain. The use of eccentric strengthening has been shown to be a beneficial physical therapy intervention in the treatment of tendinopathy. He received physical therapy intervention for the right foot emphasizing specific eccentric plantar intrinsic manual resistive exercises in varying degrees of talocrural joint positioning for his right foot according to individual intrinsic muscle actions to address each specific muscle.

Outcomes: After 4 weeks of this specific intervention program, the patient reported a pain reduction on the right from 7/10 to 4/10 on the numeric pain-rating scale (NPRS) while the left plantar heel pain remained a 7/10. The patient verbalized that he initially considered a plantar fascia release on the right; however, he stated this may not be necessary based on his physical therapy progress in pain reduction and improved functional load tolerance of his right foot.

Discussion: Based on the similar proximal anatomical attachment site and collective function of FDB, AH, and medial head of QP relative to the plantar fascia, it is likely that these structures may also be involved in cases of chronic plantar heel pain. In cases of chronic plantar heel pain, the plantar intrinsic muscles and the integrity of their proximal tendinous origin should be considered and treated in conjunction with the plantar fascia. Future studies should investigate the potential of PPTT with a larger sample to determine whether the specific interventions in the above program are beneficial for this population.

Factors Associated with Booster Visit Prescription in Adults with Low Back Pain

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Purpose/Hypothesis: Physical therapists are responsible for “managing an individual’s movement system across the lifespan.” One example of this is periodic booster visits to manage chronic conditions. Providing booster visits may maintain the beneficial effects of initial treatment, as well as prevent recurrence or worsening of the condition. It is known that booster visits benefit people with chronic musculoskeletal pain. One thing that is not known are the factors associated with those who require multiple booster visits. Our purpose was to describe the factors that are associated with the need for more than 1 booster visit in adults with chronic low back pain (LBP).

Number of Subjects: Fifty-two participants with chronic LBP (18 male; mean ± SD age, 39.2 ± 11.5 years).

Materials/Methods: As part of a randomized clinical trial, participants received 6 weekly, 1-hour treatments. Half of the participants were randomized to receive booster visits 6 months after completion of the initial treatments. Participants were prescribed 1 to 3 booster visits. Discharge from the booster visits was based on independence in performance of the home exercise program (HEP). Self-report measures were collected at baseline, during the initial treatment phase, over the 6 months posttreatment, and at the booster visits. Measures included demographics, LBP history, pain, disability, fear, absenteeism, presenteeism, physical and mental health, and HEP adherence. Frequency and percentage of participants who required more than 1 visit were calculated. Logistic regression was used to evaluate association of self-report variables with the need for more than 1 visit. Significance was set at P≤.05.

Results: Fifty-two participants attended booster visits; 23 (44.2%) required more than 1 visit. Male gender (P=.02), higher age (P=.02), and poorer physical health (P=.02) at baseline were associated with needing more than 1 booster visit. Higher disability (P=.03) at the end of the initial treatment phase, or higher current (P=.04) or worst pain (P=.01) or disability (P=.03) at the initiation of the booster visits were also associated with the need for more than 1 visit. Finally, lower adherence to the HEP in months 3 to 6 posttreatment was associated with needing more than 1 visit (all, P<.05).

Conclusions: Nearly half of the participants required more than 1 booster visit. Males and older, less healthy participants were more likely to need multiple visits. Participants who, after the initial treatment phase, had higher levels of pain, disability, or tended to be less adherent to their HEP were more likely to need more than 1 visit.

Clinical Relevance: Our data point to individual characteristics, such as gender, age, and severity level, that may assist clinicians in determining the number of booster visits that will be needed. Clinicians should also educate patients about the importance of adherence to their HEP postdischarge to manage their condition. Our data also suggest that to maintain the beneficial effects obtained in an episode of care, booster visit schedules will likely need to vary based on individual factors such as those identified in this study.
synthesis of the literature was to determine physical examination findings leading to the most effective way to identify and diagnose a pectoralis major tear, guiding the clinician to a decision of nonsurgical versus surgical intervention. Often, this tear is overlooked or misdiagnosed resulting in longer recovery times. Identifying a pectoralis major tear is essential followed by determining the severity and location of the tear which leads to what kind of intervention will be most successful. This will prove beneficial in producing more positive outcomes regarding pectoralis major muscle tears.

**NUMBER OF SUBJECTS:** Twelve studies utilizing 484 subjects.

**MATERIALS/METHODS:** Research databases were search to include Cinahl Complete, Cochrane, Medline, and Sport Discus using the search terms of “pectoralis major,” “partial,” “tear,” and “rupture.” After narrowing the search by time frame, title/abstract screening, followed by a full text review, 12 studies remained. A group of 6 reviewers critically synthesized the remaining studies mining for any physical examination finding used to identify pectoralis major tear and/or factors leading to a surgical versus nonsurgical decision for the subjects.

**RESULTS:** The critical synthesis revealed several key clinical physical examination findings that help to accurately identify pectoralis major tears. All included studies identified magnetic resonance imaging (MRI) as the most effective way to diagnose the severity and location of a tear leading to a surgical versus nonsurgical decision.

**CONCLUSIONS:** Pectoralis major tears are becoming more common and the lack of exposure to these injuries have led to many tears being misdiagnosed or overlooked completely. The following clinical signs can be used to determine if the injury is of pectoralis major origin: pain and/or tenderness, abnormal axillary contour upon palpation, ecchymosis, pain with resisted adduction, swelling, and a palpable defect. To fully know the severity and location of the tear, a magnetic resonance image is necessary. Depending on the severity shown by the MRI image, conservative management may be possible in lieu of surgical intervention.

**CLINICAL RELEVANCE:** As physical therapists are gaining more autonomy, it is vital that the therapist know and utilize the concrete signs and symptoms of a pectoralis major tear. This will allow a more efficient and effective decision regarding the use of MR imaging. Based on the severity and location of the tear as determined by magnetic resonance imaging, conservative intervention (physical therapy) may be warranted. Conservative intervention that is performed by the physical therapist is much more cost effective and beneficial to patients. If surgical intervention is warranted, critical time is not lost in moving forward toward the most effective intervention.

**OP065**

**TITLE:** Gluteus Medius Strengthening in Chronic Low Back Pain: A Pilot Study

**AUTHORS:** Nicholas Cooper, Kathleen Sluka

**INSTITUTIONS:** Physical Therapy Department, St Ambrose University, Davenport, Iowa; University of Iowa, Iowa City, Iowa

**PURPOSE/HYPOTHESIS:** Low back pain (LBP) is a common problem with chronic low back pain (CLBP) accounting for the bulk of the burden of LBP. Exercise interventions are effective in the management of LBP with current clinical thinking matching specific interventions to subpopulations. Although gluteus medius weakness has been reported to be common in people with CLBP, none of these subgroups focus on the role of gluteus medius dysfunction in CLBP. This project is a pilot comparing the effectiveness of a gluteus medius strengthening intervention with a stabilization intervention in people with CLBP who have gluteus medius weakness.

**NUMBER OF SUBJECTS:** Fifty-six.

**MATERIALS/METHODS:** People with CLBP were recruited from the community. To be included, potential participants must have had less than 4 out of 5 gluteus medius muscle strength on manual muscle testing and palpation tenderness over the low back region on exam. Potential participant tenderness over the low back region on exam. Potential participants must have had less than 4 out of 5 gluteus medius muscle strength on manual muscle testing and palpation tenderness, abnormal axillary contour upon palpation, ecchymosis, pain with resisted adduction, swelling, and a palpable defect. To fully know the severity and location of the tear, a magnetic resonance image is necessary. Depending on the severity shown by the MRI image, conservative management may be possible in lieu of surgical intervention.

**CONCLUSIONS:** Pectoralis major tears are becoming more common and the lack of exposure to these injuries have led to many tears being misdiagnosed or overlooked completely. The following clinical signs can be used to determine if the injury is of pectoralis major origin: pain and/or tenderness, abnormal axillary contour upon palpation, ecchymosis, pain with resisted adduction, swelling, and a palpable defect. To fully know the severity and location of the tear, a magnetic resonance image is necessary. Depending on the severity shown by the MRI image, conservative management may be possible in lieu of surgical intervention.

**CLINICAL RELEVANCE:** As physical therapists are gaining more autonomy, it is vital that the therapist know and utilize the concrete signs and symptoms of a pectoralis major tear. This will allow a more efficient and effective decision regarding the use of MR imaging. Based on the severity and location of the tear as determined by magnetic resonance imaging, conservative intervention (physical therapy) may be warranted. Conservative intervention that is performed by the physical therapist is much more cost effective and beneficial to patients. If surgical intervention is warranted, critical time is not lost in moving forward toward the most effective intervention.
subluxations. Her pain was temporarily relieved with a cortisone injection.

Her activity limitations included reaching overhead, reaching behind her back, carrying/lifting objects, and difficulty sleeping comfortably. Participation limitations included difficulty with her leisure activities such as walking her dog, knitting, and performing household chores. She lives in a 2-story house with a supportive family and she has a daughter that also suffers from EDS-HT.

OUTCOMES: Patient attended PT sessions 2 times per week for 8 weeks. Interventions included strengthening exercises to left shoulder and scapular musculature, manual resistance rhythmic stabilization and Bodyblade exercises. Outcome measures included MMT, ROM, and administration of the QuickDASH. Findings at discharge revealed improved strength to left shoulder flexion, abduction, internal and external rotation. Middle trapezius, lower trapezius and rhomboid strength also improved. Patient achieved ROM gains in all Left shoulder motions, negative Apprehension test, QuickDASH score improvement to 18.18% impaired (from 52.27%) and reported no pain.

DISCUSSION: This program was effective in improving left shoulder stabilization through increasing strength and ROM while decreasing pain. There is a need for future studies with a larger sample size and with long-term follow-up to further determine the effectiveness.

ed conditions initially answered no to the screening question. This disassociation may indicate that although a movement related condition may be present, patients may not initially understand the impact it has on their lives and thus do not report it to their primary care provider. Since delay in addressing movement related conditions results in increased long-term disability and added cost to the health care system, it is imperative to improve patient awareness and implement systems to discover these problems in the primary care setting. Future research should continue to examine screening methods with the progression toward a simple system for the detection and referral of movement related conditions to minimize more costly comorbid problems and improve patients’ lives.

**CLINICAL RELEVANCE:** Physical therapists are experts in movement and equipped to treat movement related conditions. Despite a 39% point prevalence of movement related conditions only 8.5% of Medicare beneficiaries utilized outpatient physical therapy services in a given year. A study that utilized EMR data showed that less than 1% of the adult population had documented physical therapy use. This discrepancy indicates that there are many movement related disorders that are not currently being treated. It is imperative that we use our knowledge to improve patient and physician awareness of movement related conditions. In doing so we hope to decrease the time that a patient waits to address a movement related condition.

**OP069**

**RELIABILITY AND VALIDITY OF THE HALO DIGITAL GONIOMETER FOR SHOULDER RANGE OF MOTION IN HEALTHY SUBJECTS**

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**PURPOSE/HYPOTHESIS:** Range of motion (ROM) of the shoulder serves as an integral component of musculoskeletal assessment in those with shoulder impairments and is typically measured using a universal goniometer (UG). While the UG has good intra and interrater reliability for measuring shoulder ROM, there are limitations to this tool such as the need for bimanual control and adequate vision. Recently, alternative measurement devices such as smartphone applications and digital goniometers have been introduced, potentially addressing some of these limitations. The purpose of this study is to investigate the intrarater and interrater reliability and concurrent validity of active shoulder ROM measurements using a digital goniometer and the UG.

**NUMBER OF SUBJECTS:** A convenience sample of 41 healthy volunteers were enrolled. Participants were recruited from the staff, faculty, and students of the UCSF/SFSU Graduate Program of Physical Therapy. Participants included 30 women and 11 men with an age range of 18 to 70 years.

**MATERIALS/METHODS:** Complex shoulder flexion, abduction, internal rotation, and external rotation were measured for each shoulder as described by Norkin and White. Two assessors independently measured each motion twice with the UG and the digital goniometer for a total of 32 measurements per shoulder. The evaluators were blinded to the results of the digital goniometer. The intraclass correlation coefficients (ICC) for inter and intrarater reliability were calculated using a 2-way mixed model, with 95% confidence intervals. ICCs and 95% CI: were also calculated to evaluate agreement between the measurements obtained from the 2 devices.

**RESULTS:** Data were analyzed for 75 shoulders (39 right, 36 left) from 41 participants. Intrarater reliability for the HALO ranged from ICC1,1 = 0.819 to 0.941, and for the UG ICC1,1 ranged from 0.844 to 0.951. Interrater reliability for the HALO ranged from ICC1,2 = 0.885 to 0.976, and for the UG ICC1,2 ranged from 0.899 to 0.976. ICCs for agreement, comparing the HALO digital goniometer to the UG, ranged from ICC1,2 = 0.787 to 0.987.

**CONCLUSIONS:** ICCs for interrater reliability, intrarater reliability, and validity for the digital goniometer and the UG were all above 0.75 and thus all were considered “excellent.” The HALO laser guided digital goniometer may be a viable alternative goniometric device for practitioners to use in the clinic to measure complex shoulder ROM. Further research must be done to investigate the reliability and validity of this device as compared with a UG on patients with pathological conditions of the shoulder, as well as its accuracy in measuring the ROM of other joints.

**CLINICAL RELEVANCE:** As an alternative goniometric device, the HALO laser guided digital goniometer may address clinical challenges observed when performing ROM measurements. When compared to the UG, the HALO does not require bimanual control, may improve safety, efficiency, and visibility for clinicians when measuring ROM.

**OP070**

**DEGREE OF TENDON STRUCTURAL CHANGE RELATES TO SYMPTOMATIC RECOVERY IN PATIENTS WITH ACHILLES TENDINOPATHY**

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**PURPOSE/HYPOTHESIS:** The purpose of this study was to describe the differences at initial evaluation between patients with Achilles tendinopathy who had full symptomatic recovery at 6 months versus those who did not. The secondary purpose was to explore the relationships between change in symptoms and changes in tendon geometry, viscoelastic properties, and lower leg function.

**NUMBER OF SUBJECTS:** Fifteen subjects with confirmed midportion Achilles tendinopathy were dichotomized into recovered (n = 5) and not recovered (n = 10) groups based on self-reported symptoms at 6-month follow-up, with a cutoff score of 85 or greater on the Victorian Institute of Sport Assessment-Achilles (VISA-A).

**MATERIALS/METHODS:** Subjects completed the VISA-A, the Tampa Scale for Kinesiophobia, the Pain Catastrophizing Scale, and a Physical Activity Scale used in Achilles tendon research to measure symptom severity, fear of movement, catastrophic thinking and current activity levels. Demographic, anthropometric, and injury information was obtained. On both the more and less symptomatic sides, extended field of view ultrasound imaging, continuous shear wave elastography, and an established functional test battery for Achilles tendinopathy were performed to measure tendon thickness, viscoelastic properties, work performed on the heel-rise endurance test and jump height. All measures were repeated at a 6-month follow-up with no systematic intervention between visits. Limb symmetry index (LSI) was calculated for all data collected bilaterally. Parametric statistics were used to analyze differences between groups. To explore the relationships between changes in symptoms and changes in tendon geometry, viscoelastic properties, and function of the more symptomatic side over 6 months, Pearson correlations were used after all subjects were pooled.

**RESULTS:** All data are presented in mean ± SD. Tendon thickness at initial evaluation was significantly (P = .02) more symmetrical for subjects who had full symptomatic recovery at 6 months (LSI, 119.9 ± 22.7) compared to those who did not (LSI, 172.8 ± 55.9). However, there were no significant differences (P = .07-.90) between groups for all other outcome variables including demographics, symptoms, fear of movement, viscoelastic properties, and function. A fair relationship was found between changes in symptoms and changes in tendon thickness (r = –.42, P = .12), and work performed on the heel-rise endurance test (r = .49, P = .06). No relationship (r = –.04 to 0.25, P = .38–.91) was found between changes in symptoms and viscoelastic properties or jump performance.

**CONCLUSIONS:** Tendon thickness (ie, tendinosis) appears to be a critical factor in attaining symptomatic recovery after 6-months in those with Achilles tendinopathy. Additionally, improvements in symptom severity are associated with normalization of tendon structure and functional gains.
**OP071**

**THE EFFECTS OF BACK SCHOOL ON PAIN AND DISABILITY IN PATIENTS WITH LOW BACK PAIN: A SYSTEMATIC REVIEW**

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**PURPOSE/HYPOTHESIS:** Introduction: Back pain is one of the most prevalent and debilitating pathologies in the United States today. Approximately 80% to 85% of the population will suffer from low back pain at some point in their lifetime. This condition presents a significant burden on the individual as well as society at large. Back school has been used as an intervention for those with LBP but its effectiveness has been questioned. Back school consists of education in such things as spinal anatomy, pathology, ergonomics, posture and performance of activities of daily living. **Pathology:**: This systematic review examined the effectiveness of back school as an intervention in treating patients with low back pain (LBP) for improving pain and/or disability.

**NUMBER OF SUBJECTS:** Not applicable.

**MATERIALS/METHODS:** Using EBSCOhost; the CINAHL, Cochrane, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, MEDLINE, and SPORTDiscus databases a search was conducted relating to the topic of back school and low back pain. Using these databases, and the PRISMA Search Strategy, 6 randomized controlled trials were included in this systematic review. To be included, a score of ≥7/10 on the PEDro scale was necessary.

**RESULTS:** Of the interventions used in the reviewed studies back school was found to be least effective compared to other interventions (exercise, exercise and relaxation techniques, McKenzie method, and manual therapy/manipulation) for improving pain and disability.

**CONCLUSIONS:** Back school is not as effective as other interventions utilized in the physical therapy clinic at reducing pain and disability.

**CLINICAL RELEVANCE:** Clinicians should not use back school as a stand-alone intervention in the treatment of low back pain. Rather, the inclusion of other evidence based interventions should be utilized to reduce pain and disability.

**OP072**

**KINESIO TAPE HAS NO EFFECT ON SHOULDER PROPRIOCEPTION, MOVEMENT CONTROL, OR STRENGTH WHEN USING ROBOTIC ASSESSMENT**

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**PURPOSE/HYPOTHESIS:** To determine if Kinesio Tape (KT) produces significant increases in upper extremity proprioception, movement control, and strength using robotic assessments conducted with KINARM End-Point Lab and Biodex System 3 Pro Isokinetic Dynamometer. We hypothesized that KT would produce greater improvements in proprioception, movement control, and strength compared to sham tape and that a larger effect would be seen in subjects symptomatic for subacromial impingement compared to asymptomatic subjects.

**NUMBER OF SUBJECTS:** Forty-one subjects (82 shoulders; mean ± SD age, 25 ± 3.4 years). Inclusion criteria: 100° of bilateral shoulder flexion/abduction, full cognitive abilities and ability to see visual stimuli. Exclusion criteria: contraindications to tape application or history of shoulder condition that would affect task performance. Neer, Hawkins Kennedy, and Internal Rotation Resisted Strength tests were employed to screen for shoulder impingement (asymptomatic, n = 72; symptomatic, n = 10).

**MATERIALS/METHODS:** Study was a prospective, double-blinded, cross-sectional, randomized control trial with a cross-over design. Subjects were randomly allocated to 1 of 2 treatment-order groups using a counterbalanced design. Facilitative taping, using either 5-cm Kinesio Tex Gold Tape or Cover-Roll Stretch tape, was applied to the deltoid by a trained PT. Subjects and outcome assessors were blinded to tape condition. Subjects performed 3 trials per arm (no tape, tape condition 1, tape condition 2) on tasks designed to assess upper extremity proprioception (KINARM Arm Position Matching, Biodex Joint Angle Matching), movement control (KINARM Visually Guided Reaching), and strength (Biodex Isometric Strength). Proprioception was measured with Absolute Error (AE) and Active Joint Position Difference (AJPD). Movement control was measured with Movement Time (MT). Strength was measured with Maximal Torque (T). Differences between baseline and tape conditions were calculated for each variable. Distributions of differences were assessed for normality (Shapiro Wilk test) then analyzed for significant differences (t-tests or Wilcoxon Matched-Pair Signed Ranks tests). Alpha was set at .05.

**RESULTS:** No significant differences were observed for any dependent variable for either tape condition (AE P = .201, AJPD P = .691, MT P = .966, T P = .487). Analysis of presence of impingement revealed no significant differences (AE P = .380, AJPD P = .896, MT P = .745, T P = .531).

**CONCLUSIONS:** Our results suggest that KT does not produce increases in upper extremity proprioception, movement control, and strength. Study limitations include a homogenous and mostly asymptomatic sample, as well as effects of practice and fatigue on task performance.

**CLINICAL RELEVANCE:** KT is widely used in clinical settings, but evidence for benefits on proprioception, motor control, and strength is limited. This study used rigorous methods to examine the benefits of KT relative to sham tape, contributing to the body of evidence on its utility.

**OP073**

**DELAYED INFECTION IN A PATIENT FOLLOWING TOTAL HIP ARTHROPLASTY**

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**BACKGROUND AND PURPOSE:** Total hip arthroplasty (THA) is a diagnosis that is commonly encountered by physical therapists. Complications of joint replacements include infection, blood clots, nerve injury and prosthetic loosening or dislocation. It is important for health care providers to be aware of the signs and symptoms indicative of these complications. The purpose of this case study is to highlight a case of delayed infection following a THA.

**CASE DESCRIPTION:** A 67-year-old woman presented 3 weeks status-post left THA, direct anterior approach (Figure A), was seen in PT for 2 months for routine rehab, and returned to work as a nurse. A week after returning to work, patient experienced severe left buttock pain and was diagnosed with degenerative L5-S1 Spondylolisthesis and foraminal stenosis. She returned to PT and simultaneously received lumbar spine epidural injection. This conservative treatment failed and she underwent L5-S1 fusion and laminecmy (5 months after THA). Patient returned to PT status-post fusion. Her presentation deteriorated during the course of PT. Her left buttock pain worsened with a declining gait pattern, relying on her cane. Her left hip flexor and extensor strength diminished from 4/5 to 2/5. She was afebrile with no warmth to palpation. PT sent the patient back to the referring physician.

**OUTCOMES:** Anterior view radiographs showed a medial protrusion of the L hip arthroplasty device with violation of the pelvic wall and lucency about the femoral component indicating loosening. She underwent an emergent THA revision. Cultures for bacteria showed a rare strain of oral bacteria, Parvimonas micra. Patient was admitted for IV antibiotics. She returned to outpatient physical therapy, completed the course and was able to return to full duty work.
DISCUSSION: Infection following a knee or hip replacement occurs in less than 1% of patients. Infections are classified as early (less than 3 months), delayed (3-24 months), or later (more than 24 months). Complications of infection include prosthetic component loosening and failure and should be considered when establishing differential diagnoses in patients presenting with joint pain who have a history of total joint replacement.


OP074

FATIGUE-ASSOCIATED CHANGES IN SCAPULAR CONTROL AND SERRATUS ANTERIOR


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PURPOSE/HYPOTHESIS: Individuals with shoulder pathology are likely to have altered scapular kinematics and serratus anterior (SA) muscle performance. There are few clinical tools that are capable of collecting specific and efficient data on alterations in scapular motion and SA muscle performance. The primary purpose of this study was to determine the effectiveness of accelerometers for detecting changes in scapular motion and ultrasound imaging for measuring changes in SA muscle contractility following a shoulder fatiguing task. The secondary purpose of this study was to compare the accelerometer and ultrasound measures in those with observable scapular dyskinesia to those without dyskinesia

NUMBER OF SUBJECTS: Twenty-six subjects (mean ± SD age, 24 ± 2 years; 50% male; 100% right handed).

MATERIALS/METHODS: Healthy subjects were screened for scapular dyskinesia. Subjects were positioned in a standardized sitting posture and anatomical references were marked on the SA for the ultrasound (Mindray MSK Z6), and scapula for both the wired accelerometer (Biopac, TSD109C2) and smartphone accelerometer (Sensor Kinetics Pro). After the accelerometers were secured with kinesiology tape, subjects performed 3 repetitions of seated scapular lifting with a 10°/s. Acceleration of the scapula was collected through the entire range of motion, while ultrasound images of the SA were taken at rest and at 120° of scapular elevation. After pretest data were recorded, the subject began the fatigue portion of the experiment without data collection. The subject performed repeated shoulder elevation in the same scapular plane as in the prefatigue phase. Repeated shoulder elevation was limited to 90° to 120° at a pace of 60 bpm while holding weight equal to 20% of the volunteer’s maximum volitional isometric contraction. The postfatigue test followed and was identical to the prefatigue test. SA thickness measures were obtained post hoc with manufacturer software. Percent change in thickness was calculated by subtracting the average rest value from the average contractile value, and dividing the difference by the average rest value. Paired t test was used to compare pre fatigue measure of muscle thickness and scapular acceleration to post fatigue measures.

RESULTS: Both accelerometers showed a significant increase (P<.01) for postfatigue measures compared to prefatigue in all planes of motion. We also found a significant increase (P<.01) in postfatigue measures in those with dyskinesia.

CONCLUSIONS: This study demonstrates that both the smartphone accelerometer and wired accelerometer detected fatigue-associated changes in scapular motion. Further research on a pathological population is needed in order to validate these tools for clinical use.

CLINICAL RELEVANCE: Smartphone accelerometry has the potential to be a valuable clinical tool for assessing the quality of scapular motion while the value of assessing the SA with ultrasound imaging is still not well understood.

OP075

KINESIO TAPING INCREASES THE ACROMIOHUMERAL DISTANCE IN INDIVIDUALS WITH SYMPTOMATIC ROTATOR CUFF TENDINOPATHY

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PURPOSE/HYPOTHESIS: To investigate the short-term effects of Kinesio Taping (KT) on the acromiohumeral distance (AHD) in individuals with symptomatic rotator cuff tendinopathy (RCTe). Since, KT has been previously shown to increase AHD in healthy subjects, we hypothesize that KT will provide a significant increase of AHD in individuals with symptomatic RCTe.

NUMBER OF SUBJECTS: Twenty-six individuals diagnosed with RCTe were recruited from the mailing list of the local university.

MATERIALS/METHODS: The AHD was measured using an ultrasound scanner (Logic e9; GE Healthcare, Milwaukee, WI) with a 4-15-MHz linear array probe (model ML6-15-D). Measurements of AHD were taken pre-KT and post-KT application in 2 arm positions (0° and 60° of abduction), with participants seated up straight against the backrest of the chair, looking straight ahead. First, 2 measures of AHD with the arm at 0° and 60° of abduction, without KT, were taken. Thereafter, after proper skin cleansing, therapeutic KT for RCTe was applied on the symptomatic shoulder. The Kinesio Tex Classic was applied using a combination of techniques designed for RCTe. All applications followed the principles described by Kase et al (2003) and were applied by the same physiotherapist, who is a practitioner certified by the Kinesio Taping Association International (KTAI). Ten minutes after the application, measurements of AHD at 0° and 60° were retaken.

RESULTS: A 2-way analysis of variance (ANOVA) for repeated measures revealed that the application of KT led to a significant increase in the AHD, at both 0° and 60° of abduction (P<.05).

CONCLUSIONS: Therapeutic KT provided an immediate increase in the AHD in symptomatic patients with RCTe. Therefore, KT may be useful to reduce the symptoms associated with the narrowing of the subacromial space. Further studies investigating long-term effects of KT on AHD as well as the effects of KT on underlying symptoms of RCTe are still needed to confirm its positive effects.

CLINICAL RELEVANCE: The present results will contribute to building a solid framework of evidence for the use of KT within a clinical setting and to the development of more effective approaches and treatments for patients with RCTe. They provide new insights on the use of KT in the rehabilitation of symptomatic patients with RCTe.

OP076

THE RELATIONSHIP BETWEEN HIP STRENGTH, RUNNING GAIT FOOT-STRIKE PATTERN, AND RUNNING-RELATED INJURY

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PURPOSE/HYPOTHESIS: A potentially high proportion of long distance runners will sustain a running-related injury (RRI). Runners with a rearfoot
striking pattern may be more susceptible to RRI as it results in greater power absorption at the hip and knee. Strength deficits in hip flexion and hip abduction have been found to be associated with an increase in lower extremity overuse injury. Thus this study aimed to examine foot strike pattern and gross hip muscle strength in runners with and without a history of RRI. Hip strength and foot strike characteristics were examined and differences in these factors between groups of runners with and without a history of RRI were evaluated.

**NUMBER OF SUBJECTS:** Twenty-five.

**MATERIALS/METHODS:** Twenty-five participants (9 male, 16 female; mean ± SD age, 26.80 ± 9.63 years) were recruited for this study. All participants were older than 18 years of age, ran greater than 10 mi/wk over the past 3 months and were without recent RRI. Strength measures were obtained by a single researcher using a handheld dynamometer. Subjects ran at a self-selected training pace on a treadmill and 2-D video analysis of foot strike angle, cadence, and stride length was performed using Hudl Technique application. Independent samples *t* tests examined group differences between those with and without history of running-related injury, while a Pearson correlation was conducted to assess the relationship between the running gait characteristics and hip strength. Due to high agreement between left and right lower extremity measures for both the strength and gait variables, these were averaged to a singular construct for each

**RESULTS:** Independent samples *t* test found that runners without a history of RRI had greater normalized strength for hip flexion (*P* = .008, *d* = 1.14), abduction (*P* = .043, *d* = 0.87), internal rotation (*P* = .006, *d* = 1.21), and external rotation (*P* = .005, *d* = 1.28). There were no group differences (*P* >.05) in abduction strength or foot strike angles. However, there was a significant association between foot strike angle and hip adduction strength (*P* = .017, *r* = 0.472).

**CONCLUSIONS:** These findings are consistent with previous reports of decreased incidence of RRI in runners with increased hip flexion strength, while also adding new evidence suggesting strength of the hip adductors, internal, and external rotators may also be associated. Although this study identified a very large effect size for these muscle groups, contrary to other studies, the hip abduction strength was not significantly different between those with and without RRI. In addition, this study identified an association of greater foot strike angle and adductor strength which warrants further investigation

**CLINICAL RELEVANCE:** This study presents strong evidence suggestive of relationship of hip strength with RRI. Results suggest that both hip strength and running mechanics should both be taken into consideration when rehabilitation recreational runners as the cause of RRI is likely multifactorial. Future clinical studies examining running gait from all anatomical planes may provide valuable insight into gait evaluation and injury prevention.
A total of 654 articles were screened for eligibility resulting in 7 comparative studies, 6 cohort studies and 1 case-control. MINORS scores came to consensus based on MINORS scale guidelines. The risk of bias of the included trials was moderate to high. Only 2 studies were considered low risk of bias. The first study was a randomized controlled trial and the second was a prospective cohort study. The included studies were of low quality and there was a high degree of heterogeneity. The results of the included studies were mixed and there was a lack of consensus on the effectiveness of MPKs. The authors concluded that there is moderate evidence to support the use of a MPK over a non-MPK in individuals with unilateral TFA when examining functional mobility. When comparing MPKs, Genium resulted in improved safety and function in walking after stroke. The use of a MPK can significantly impact independence with ADLs and participation in work/leisure activities in individuals with unilateral TFA. The Genium appears to be the best option compared to C-leg and non-MPK to promote the highest level of functional mobility and patient satisfaction. Clinicians should consider the patient's current and potential functional mobility (K level 3-4), work/play/leisure activities, decreasing fall risk. Future research is needed on different age groups and activity levels using both MPK and non-MPK prostheses with long-term follow-up to determine optimal outcome measures and training parameters to maximize functional mobility in this population.

**REFERENCES:**

**OP079**

**THE IMPACT OF USING A UNILATERAL MICROPROCESSOR PROSTHETIC KNEE FOR INDIVIDUALS WITH TRANSEMMORAL AMPUTATION ON FUNCTIONAL MOBILITY: A SYSTEMATIC REVIEW**

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**PURPOSE/HYPOTHESIS:** To investigate the impact of using a microprocessor knee (MPK) prostheses for individuals with a unilateral transfemoral amputation (TFA) on functional mobility.

**NUMBER OF SUBJECTS:** Not applicable.

**MATERIALS/METHODS:** A literature search included: CINAHL, PubMed, ProQuest, ScienceDirect, and Cochrane Library using search terms (transfemoral amputation) AND (microprocessor OR C-leg OR Genium). Selection criteria: adults older than 18 years, unilateral TFA, MPK, and outcome measures related to functional mobility. Powered prosthetic knees excluded. Search limits: human subjects, English and peer reviewed. Two reviewers independently assessed each study for methodological quality and came to consensus based on MINORS scale guidelines.

**RESULTS:** A total of 654 articles were screened for eligibility resulting in 7 comparative studies, 6 cohort studies and 1 case-control. MINORS scores ranged from 17 to 21 (average, 18.7/24). Sample size ranged from 10 to 41 subjects (n = 156). Age ranged from 21 to 83 years (average, 39.2). Prosthetic experience ranged from none to greater than 1 year. The accommodation period ranged from greater than 2 weeks to less than 3 months. Four of 7 studies found that the Genium had statistically significant improvements in stair ascent/descent, slope and ramp navigation, gait speed and safety. One study found that the Genium scored significantly higher on the Prosthesis Evaluation Questionnaire (PEQ) in perceived response, social burden, utility and well-being scales when compared to the C-Leg. All 4 studies showed the majority of individuals preferred the Genium when performing ADLs. One study examined physical performance (CS-PFP10) and found the Genium was not significantly different from nonamputee controls, while the C-leg users showed significantly lower function. Three of 7 studies showed improved outcomes with the use of a MPK, specifically stair and ramp negotiation, and a decrease in fall frequency when compared to non-MPK users.

**CONCLUSIONS:** There is moderate evidence to support the use of a MPK over a non-MPK in individuals with unilateral TFA when examining functional mobility. When comparing MPKs, Genium resulted in improved safety and better performance on uneven terrain versus C-leg as well as non-MPK devices, decreasing fall risk. Future research is needed on different age groups and activity levels using both MPK and non-MPK prostheses with long-term follow-up to determine optimal outcome measures and training parameters to maximize functional mobility in this population.

**CLINICAL RELEVANCE:** The use of a MPK can significantly impact independence with ADLs and participation in work/leisure activities in individuals with unilateral TFA. The Genium appears to be the best option compared to C-leg and non-MPK to promote the highest level of functional mobility and patient satisfaction. Clinicians should consider the patient's current and potential functional mobility (K level 3-4), work/play/leisure activities, decreasing fall risk. Future research is needed on different age groups and activity levels using both MPK and non-MPK prostheses with long-term follow-up to determine optimal outcome measures and training parameters to maximize functional mobility in this population.

**REFERENCES:**
PREDICTION OF INJURY AMONG ELITE DANCERS: 4 YEARS OF PROSPECTIVE SURVEILLANCE
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PURPOSE/HYPOTHESIS: Injuries in dance are commonplace and distressing in terms of human and financial impact. It is the goal of dance medicine health care professionals and educators to detect risk for injury prospectively, often through screening efforts. It is known that screening has been very useful for rapport building, improving health literacy and way finding to local health care systems, however screening, as we have been conducting it, has still not proven to be predictive of injury despite implementation of preventative interventions such as preseason conditioning programs. The purpose of this study was to test the predictive validity of 4 patient reported outcomes (PRO) in addition to an array of motor control based clinical performance based outcomes (CPBO) collected during preseason screening in predicting subsequent season time loss injury.

RESULTS: The PRO variables DRS, WHO and EAT were associated with the outcome variables (P ≤ 0.05) in functional outcomes, either self-reported (WOSI Score MD, 2%; 95% CI: –8.9%, 4.9%) after 10 years or with a composite scale (ROWE Score MD, 3%; 95% CI: –3.8%, 9.8%) at 2 years postsurgery were found. No significant differences (P ≤ 0.05) in recurrence of instability were observed between the 2 procedures. Pooled results from 2 trials (n = 102) comparing an arthroscopic Bankart repair to open Bankart repair demonstrated a significant difference (P ≤ 0.05) favoring the open procedure for self-reported function (MD, 2.82%; 95% CI: 0.62%, 5.01%). A meta-analysis including 7 studies (n = 490), reported significantly more recurrence of instability (P ≤ 0.05) for Bankart repairs performed arthroscopically (17/242) compared to an open approach (34/248) and a meta-analysis including 5 studies (n = 361), found significantly more adverse effects (P ≤ 0.05) with open Bankart repair (13/180) at 2 years after surgery compared to arthroscopic Bankart repair (4/181).

CONCLUSIONS: This systematic review highlights that despite the considerable number of trials investigating surgical interventions for recurrent anterior shoulder instability in adults, the overall quality of the evidence is low. The current evidence does not permit to make specific clinical recommendations. Further high quality RCTs should be made before making recommendations.

CLINICAL RELEVANCE: In the absence of high quality evidence regarding the best surgical procedure, clinicians should discuss with their patients the available surgical options and other potentially important factors that may influence a successful outcome.
ization and noninflammatory/mechanical properties of intervertebral disc tissue (genetic markers [MMp2, IL6, VDR] and MRI [inflammation Modic changes]; absence of biomarker [Hs-CRP] with clinical presentation of obesity and history of related trauma) is warranted in order to better inform physical therapists on patients’ mechanical response to systematic evaluation and intervention.

**OP083**

**WORK PERFORMANCE AND RESIDUUM ANTHROPOMETRICS IN HEALTHY MEN WITH TRANSTIBIAL LIMB LOSS: 12-MONTH FOLLOW-UP**

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**PURPOSE/HYPOTHESIS:** Despite advances in prosthetic management and rehabilitation, otherwise healthy men with transtibial limb loss (TTLL) risk residuum injury during work-related activities (WRAs). Little is known about work performance or residuum anthropometric changes over time in this cohort. The purpose of this study was to examine and compare performance measures of gait and other WRAs, perceived exertion and selected residuum measures at 2 time points, 12 months apart in otherwise healthy men with unilateral TTLL. We hypothesized that there would be a comparative asymmetry in gait as measured by step length, stride length, and cadence during self-paced and brisk gait as well they would demonstrate less capacity in lift and carry testing, report increased exertion, as well as a decrease in residuum measures (girths, length) across a 12-month period of time.

**NUMBER OF SUBJECTS:** Twenty-one men with transtibial limb loss.

**RESULTS:** Participants showed little difference between visits in residuum anthropometrics or in distances walked (self-paced, brisk 2MWT; P > .05). All had received rehabilitation, varying from time after surgery following initial period of rehabilitation. No improvement on the initial period of rehabilitation (n = 8, 38%) to only upon receipt of the initial period of rehabilitation (n = 13, 62%). However, participants reported greater exertion at visit 2 during the brisk 2MWT (0.9 RPE difference; P = .034); lifted 40.4 lb more at visit 2 than at the initial visit (P = .034); demonstrated progressively larger cadence difference from visit 1 to visit 2 (increased asymmetry) during the timed self-paced walk test (P = .026).

**CONCLUSIONS:** Despite improved lift capacity or residuum anthropometric stability, this healthy male cohort with TTLL demonstrated progressively worsened cadence asymmetry during self-paced 2MWT and reported increased exertion during brisk-paced 2MWT.

**CLINICAL RELEVANCE:** Otherwise healthy working-age men with TTA may require continual intervention to minimize cadence asymmetry and perceived exertion, potentially reducing residuum injury risk. Physical therapists may need to consider advocating life-long fitness and regular clinical visits to monitor gait and work performance.

**OP084**

**THORACIC THRUST MANIPULATION AND EXERCISE FOR THE TREATMENT OF FAILED BACK SURGERY SYNDROME: A CASE SERIES**

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**BACKGROUND AND PURPOSE:** Low back is prevalent in the U.S. with spinal surgery becoming increasingly popular regardless of increasing health care cost and poor outcomes. Revision spinal surgeries have a high failure and there’s little evidence and inconsistent/limited support for interventional pain procedures. Physical therapy is the cornerstone and the first line management for Failed back surgery syndrome (FBSS) with exercise and manual therapy to reduce pain and improve function. There’s little evidence outlining the type of manual therapy and exercises for the treatment of FBSS. The purpose of this case series is to demonstrate the effectiveness and safety of specific manual therapy with “thoracic manipulation” and exercise using a multiphased algorithm for the treatment of FBSS.

**CASE DESCRIPTION:** Three patients—a 33-year-old woman, 68-year-old woman, and a 82-year-old man—were treated in an outpatient physical therapy setting after having spinal surgery for mechanical low back pain. All 3 patients were assessed using a lumbar screen and treated with spine thoracic manipulation and exercise.

**OUTCOMES:** Patients were treated for a total of 15 to 22 visits over a course of 7 to 13 weeks. Pain (measured by a numeric pain-rating scale) reduced to 0/10 and disability (measured by Focus On therapeutic Outcomes [FOTO]) improved to above predicted values in each patient but 1 patient which was due to lack of understanding of the questions. No adverse reactions to manipulation were reported.

**DISCUSSION:** The results of this case series describe the use of thoracic thrust manipulation and exercise for the treatment of mechanical LBP in patients with FBSS. The positive results indicate that thoracic manipulation and exercise may be a safe adjunct therapy. Further studies, including randomized controlled trials, are needed to determine effectiveness.


**OP085**

**THE ASSISTANCE OF MECHANICAL LUMBAR TRACTION IN REDUCING PERSISTENT PLANTAR FOOT PAIN**

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**BACKGROUND AND PURPOSE:** Plantar heel pain is a common symptom in adults with foot problems. Of those diagnosed, conditions often include plantar fasciitis, atrophy of the heel fat pad, or calcaneal fracture. However, plantar foot pain could arise from nerve entrapment, specifically the first branch of the lateral plantar nerve, “Baxter’s Nerve,” in 15% to 20% of patients with chronic plantar heel pain. The research and treatment is limited and the impact on physical therapy is even less understood. This report uses an impairment based model to effectively treat 3 patients with plantar foot pain with possible neural involvement.

**CASE DESCRIPTION:** Three patients with primary complaint of plantar foot pain; 2 patients with unilateral 3 month history and 1 patient with 4 year bilateral (B) history. All 3 patients did not improve with ice/heat modalities, anti-inflammatories provided both orally and via injection, orthotics, and multiple trials of physical therapy (stretching and strengthening of the ankle). Initial findings for all 3 patients include deficits in
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ankle strength as noted by HHD, inability to perform a unilateral heel rise due to pain, a negative slump test, status quo testing for peripheralization/centralization of radicular pain with repeated motions of the spine, pain levels between 9 and 10/10, and Foot and Ankle Ability Measure (FAAM) scores for ADL or Sports subscales less than 40%. Treatment for the group occurred over a period of 1 to 2 months ranging 7 to 14 visits. Patients received low-dye taping 100% of the time, mechanical lumbar traction 90% to 100% of the time, and ankle musculature strengthening 90% of the time. Ankle mobilizations was the most variable treatment as it ranged from occurring between 30% and 70% of the total treatment time. Return to sport training was implemented in 2 patients, of which was an aerobics instructor and the second being an avid runner. The third patient primarily focused on a return to walking program throughout her plan of care.

OUTCOMES: All 3 patients had a 50% reduction in their pain scores and of the 2 patients who had an available FAAM, each reached the MCID for either the ADL or Sports subscale at the conclusion of their plan of care. In response to mechanical lumbar traction, 2 patients had a complete resolution of symptoms immediately following use and 1 had no change in her pain immediately afterwards but noted 50% reduction in pain the following morning.

DISCUSSION: The use of mechanical lumbar traction in combination with a multimodal physical therapy program yielded positive outcomes in 3 individuals with persistent plantar foot pain as evidenced by improvement in pain scores particularly with walking and return to sport and patient self-reported outcomes.


OP086

MANUAL THERAPY COMBINED WITH VESTIBULAR EXERCISES IN TREATMENT OF A PATIENT WITH CHRONIC CERVICOGENIC DIZZINESS INDUCED AFTER A MASSAGE

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BACKGROUND AND PURPOSE: Dizziness originating from the cervical spine can be a disabling condition when it becomes chronic. Literature has addressed cervicogenic dizziness following whiplash injury, but not for chronic cervicogenic dizziness without an injury mechanism. This case study report describes the history, assessment results and manual therapy (MT) combined with vestibular exercises on a 33-year-old woman with chronic neck pain and dizziness.

CASE DESCRIPTION: JH reported that dizziness developed 1 hour after she received a massage in the prone position 6 years ago. She could not recall any injury or awkward motions that occurred at the onset of dizziness. Over time, the dizziness became episodic with concurrent neck pain. In addition, she no longer drove and avoided riding in the car, as both aggravates dizziness. She also reported that she received strengthening exercises from physical therapy (PT) and cervical manipulation from a chiropractor. However, neither treatment relieved her dizziness but both further aggravated symptoms. During examination, JH performed all cervical motions guardedly due to pain with noticeably limited rotation bilaterally. Cervical flexion and extension to the end range increased her dizziness. Neurological exams including reflex, sensory and strength testing of the upper extremities showed no abnormal findings. However, a soft end feel followed by spasm was noticed during the stability test of the right alar ligament. Interestingly, no abnormality was found during vestibular tests, including vestibular ocular reflex (VOR) testing. Accessory mobility testing revealed reduced mobility in the upper cervical spine including occipito-atlantal, C1-2 and C2-3 segments with a painful spasm end-feel. The Neck Pain Disability Index score on the initial visit was 24/50 indicating moderate disability and Dizziness Handicap Inventory (DHI) was 22/100 indicating mild disability. Due to lack of improvement from previous separate MT and exercises, the PT interventions included VOR and VOR cancellation exercises, as well as MT consisting of muscle energy techniques, joint mobilization and manipulation to the upper cervical spine, even though there were no abnormal findings in the vestibular tests. JH was treated for 2 visits over 2 weeks and a follow-up visits 4 weeks later.

OUTCOMES: After the first session of PT, JH reported dizziness decreased by 50% and 65% overall improvement after 2 treatments. She was able to ride in a car without exacerbating dizziness. On her 4-week follow-up visit, her NDI score was improved to 12/50 and her DHI score to 14/100. In addition, she reported a 75% overall improvement.

DISCUSSION: Although the mechanism causing her dizziness remains unclear, this patient benefitted from treatment emphasizing both MT and vestibular exercises even though no abnormality was found in the vestibular tests. This case study describes the clinical presentation and identifies potential benefits of a physical therapy program for chronic cervicogenic dizziness.


OP087

INFLUENCE OF OPIOID USE AND REFERRAL SOURCE ON PHYSICAL THERAPY TREATMENT PATTERNS AND OUTCOMES FOR PATIENTS WITH SHOULDER OR KNEE PAIN

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PURPOSE/HYPOTHESIS: The purpose of this study was to determine if opioid use and referral source influence treatment patterns and patient reported outcomes (PROs) in patients with shoulder or knee complaints. We hypothesized that patients who used opioids would display worse PROs and longer treatment duration than their nonopioid using and direct access to PT counterparts.
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**NUMBER OF SUBJECTS:** Fifty patients with shoulder or knee pain treated in a multisite outpatient PT setting in upstate South Carolina. Patients were adult beneficiaries of a local hospital health plan.

**MATERIALS/METHODS:** We utilized a retrospective cohort design to investigate the influence of opioid use and referral status on PROs and treatment patterns. Patients were enrolled into our existing PT-first program via direct-access or referral from a physician partner. We used standardized medical screening, treatment algorithms, and benchmark criteria for progress to inform need for physician referral. PT interventions were driven by respective treatment based classification systems using best evidence to guide treatment selection. Baseline and final measures of pain, PROs (Penn Shoulder Score [PENN], International Knee Documentation Committee [IKDC]), and general health (Veterans Rand 12-Item Health Survey Physical [PCS] and Mental [MCS] Component Scores) were collected. Opioid use and referral status were obtained via chart review with cooperation of a local hospital system. Comparative analyses between direct access and physician referral, and opioid and nonopioid users were performed for all baseline measures using t test and chi-square. Discharge percentage change scores for PROs (using an Analysis of Covariance-ANCOVA). A P < .05 was considered statistically significant for all measures.

**RESULTS:** Of the 50 patients, 21 accessed PT via direct-access and 47 had no recent history of opioid use. There was no difference in opioid use between patients who accessed PT via physician referral versus direct access. There was no difference in opioid use for visits, length of service, or days from first physician contact to first PT. Patients showed similar substantial improvements of 45% to 53% in PENN and IKDC scores regardless of referral status ($P = .001$) or opioid use ($P = .34$). Analyses adjusted for baseline patient demographics and characteristics, including lower IKDC ($P = .016$), PCS ($P = .01$) and MCS ($P = .008$) scores in the opioid group.

**CONCLUSIONS:** Patients had the same PT utilization and achieved similar improvements in PROs, regardless of opioid use or referral status. Findings contradict current evidence that increased physician contact and opioid use is harmful to outcomes when presenting to PT for orthopaedic complaints. Further research is needed to support or refute these findings.

**CLINICAL RELEVANCE:** Opioid use and physician referral to PT do not appear to negatively impact improvement in patient reported outcomes or treatment patterns for patients presenting with complaints of the shoulder and knee.

**OP088**

**DIFFERENTIAL DIAGNOSIS OF LOW BACK PAIN IN A CANCER SURVIVOR: A CASE STUDY UTILIZING MECHANICAL DIAGNOSIS AND THERAPY**

**Kelly Dussak McArdle, Lora Packel, Kay Scanlon, Alicia Hyon**

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**BACKGROUND AND PURPOSE:** Many cancer patients experience a myriad of issues such as cancer related fatigue (CRF) and chemotherapy induced peripheral neuropathy (CIPN). These symptoms contribute to lower activity levels, a known risk factor for development of low back pain (LBP) and possible radicular symptoms. The use of Mechanical Diagnosis and Therapy (MDT) in the differential diagnosis and treatment of LBP and radiculopathy has been successful in the general population, but has not been studied in cancer survivors with similar symptoms. Usage of MDT in differential diagnosis and treatment of a cancer survivor presenting with LBP and radicular symptoms will be described.

**CASE DESCRIPTION:** A 57-year-old woman developed LBP and radicular symptoms 5 months after chemotherapy and radiation treatments for Stage IV small cell carcinoma of the lung with metastasis to the brain. Chief complaints were 5 to 10/10 LBP and left lower extremity (LE) pain, left greater than right LE weakness, poor balance, and CRF. Outcome surveys included Revised Oswestry: 42%, Roland-Morris: 8/24, and Lower Extremity Functional Scale (LEFS): 38/80. A 25% to 50% lumbar ROM loss, positive straight leg raise, LE MMT 3 to 4+/5, TUG 14 seconds, gait velocity of 11 seconds/20 feet, and painful, blocked curve reversal with sit to stand were demonstrated. Flexion testing peripheralized and worsened symptoms while repeated and static extension in lying (EIL) and postural correction decreased and centralized symptoms. Recent labs and MDT subjective screen of symptom behavior did not indicate serious pathology. MDT provisional classification was asymmetrical derangement, above knee, without deformity with directional preference of extension. Treatment included postural correction, EIL with patient and PT overpressure, progressing to mobilization, general strengthening, and balance.

**OUTCOMES:** LE symptoms resolved in 3 visits. LBP resolved, flexion and extension ROM improved to 75% to 90%, painfree sit to stand transitions in 6 visits. At visit 14, ROM was 100%, strength increased, RM 4/24, Oswestry 24%, TUG 9 seconds, gait velocity 7 seconds/20 ft, and LEFS 35/80. Treatment progressed along MDT force progressions in extension principle then shifted to CRF interventions until visit 19 with LE strength improved to 4+ to 5/5 and LE FS 47/80 at discharge.

**DISCUSSION:** This case demonstrates that a new onset of LBP and LE symptoms may represent metastatic disease, CIPN, or musculoskeletal pathology. However, other than CRF, no other red flags, worsening of neurological signs or constitutional signs suggested metastatic disease. Consistent symptom reduction with MDT was verified objectively and excluded CIPN, which typically occurs bilaterally and involving sensory changes. With increased prevalence and risk of certain cancer recurrences, this case illustrates that MDT may serve as an effective tool in the differential diagnosis of LBP and radicular symptoms to assist with ruling out pathology requiring referral in those with or without a cancer history.


**OP089**

**THE UNIQUE ROLE OF PHYSICAL THERAPY IN SUBSTANCE ABUSE FACILITY PROGRAMMING: A CASE REPORT**

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**BACKGROUND AND PURPOSE:** Chronic pain is linked to an increased risk of substance abuse. The APTA recently began a campaign to educate the public on the viability of physical therapy care as a nonpharmacological option to treat chronic pain. Contributions outside of direct patient care by physical therapists and physical therapy students in managing the link between chronic pain and substance abuse have not been discussed or promoted. The purpose of this study was to perform a needs and resource assessment at Crossroads, a licensed substance abuse facility in Arizona, implement a program that addressed facility needs outside of administration of direct PT services and assess participant feedback of the program.

**CASE DESCRIPTION:** Crossroads is a licensed substance abuse treatment facility which utilizes the 12-step program and SMART Recovery programming. Needs and resource assessment performed with input from the program coordinators at Crossroads, program creation, and participant feedback through survey results focused on the needs of the program for those in the initial 30 days of inpatient treatment.
OUTCOMES: Needs assessment results specific to PT student knowledge included a need for improved resident knowledge regarding proper exercise techniques, nutrition, smoking cessation, pain management, fitness, and a guided exercise program. Resource assessment found that student and facility scheduling conflicts and limited facility space, equipment, and funds were incompatible with a sustainable guided exercise program. A feasible program that most effectively addressed facility needs was determined to be a 45-minute educational course focused on the benefits of exercise for health and sobriety, a breakdown of American College of Sports Medicine’s guidelines for exercise, an example exercise program which did not require gym equipment, and instruction on posture, lifting techniques, and work ergonomics. Participant feedback was received from 102 men and women in their initial 30 days of treatment from February to April 2017. 74% of participants noted that they were aware that exercise played an effective role in recovery, however 88% noted that they were more likely to be active after the presentation and 92% responded favorably to participating in an exercise program if it was offered; 98% of participants would recommend this presentation to other participants at Crossroads facilities.

DISCUSSION: Based on survey results, the program was well received by participants. Strong interest in exercise as part of the recovery process was noted by participants. Currently, a guided exercise program is not feasible with current resources, however, positive feedback suggests that an educational program may be effective in increasing the awareness of the benefits of exercise in recovery and increasing the likelihood that participants would exercise.

OUTCOMES: For outcome tracking the Lower Extremity Functional Scale (LEFS) and Patient-Specific Functional Scale (PSFS) were used to assess improvement over time. On initial evaluation this patient’s LEFS was a 29 out of 80 and PSFS was a 1.8 average score of all her activities. At discharge her LEFS score improved to a 78 out of 80 and PSFS improved to a 9.4 average which both met the meaningful clinical important difference. DISCUSSION: Increasing research has emerged which addresses degenerative changes seen in other areas of the body such as the Achilles, supraspinatus and epidicondylopathy, there is little high level of evidence to guide clinicians with degenerative changes seen at the hip especially multiple tissue deficits. This case utilizes concepts of a load management strategy to improve tendon tensile and cartilage loading to restore function. Based on her outcome measures it can be demonstrated that a proper use of activity management in combination with interventions designed to address impaired tissue loading capacity can be used to promote healing and restore function.


OP093

THE RELATIONSHIPS BETWEEN IMAGING FINDINGS OF FATTY INFILTRATION AND/OR ATROPHY OF THE LUMBAR MULTIDORS MUSCLES WITH SYMPTOMS OF BACK PAIN: A SYSTEMATIC REVIEW

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PURPOSE/HYPOTHESIS: To evaluate and summarize the literature that compares imaging findings of fatty infiltration and/or atrophy of the lumbar multifidus muscles with symptoms of low back pain (LBP).

NUMBER OF SUBJECTS: Studies reviewed, 26.

MATERIALS/METHODS: Two reviewers conducted a detailed search of 3 electronic databases: PubMed-Medline, Physiotherapy Evidence Database, and Cochrane Library. The databases were searched to include studies from 1980 to 2016. Inclusion criteria include the following: peer-reviewed journals, randomized control trials, cohort studies, case-control studies, cross-sectional studies, and case studies. Article types excluded are letters, books, commentaries, and blogs. These must be in the English language and have human participants of any age, gender, BMI, or ethnicity with history of LBP in the last 6 months. The overall quality of individual stud-
ies was independently assessed by both reviewers using the NIH QAT for Observational Cohort and Cross-Sectional Studies.

RESULTS: The initial search strategy yielded 984 articles, of which 26 were eligible for final inclusion for this review: 5 longitudinal cohort studies, 8 case control studies, and 13 cross-sectional studies. These studies used either magnetic resonance imaging (MRI) or computed tomography (CT) to measure CSA, FI, or muscle volume of trunk muscles. The average NIH QAT scores for the studies was 72% ± 9%, with the cutoff for high quality studies being greater than 75% and fair quality studies being greater than 50% but less than 75%. Of the 19 studies investigating muscle CSA, a total of 10 studies reported no association (4 high quality, 6 fair quality), and 9 studies found no association (2 high quality, 7 fair quality). Of the 16 studies investigating lumbar muscle FI, a total of 11 studies found no association (4 high quality, 7 fair quality) while 5 did not (2 high quality, 3 fair quality). Last, 1 high-quality study found no volumetric differences in the lumbar muscles between the painful and nonpainful sides in individuals with LBP.

CONCLUSIONS: There are conflicting results regarding the association between lumbar muscle morphology and LBP. This variation in findings could be from different positions during imaging, the different levels being measured, the possible variations in participants’ postures, the variations observed in spinal levels, or the different demographic characteristics of the participants. More research on homogenous participants needs to be done to determine the true relationship between morphology and LBP.

CLINICAL RELEVANCE: A better understanding of the relationship between radiological findings in the lumbar spinal musculature and pain can help direct clinicians towards more appropriate interventions when treating low back pain.

OP094

ANTIGRAVITY TREADMILL TRAINING TO INCREASE FUNCTIONAL ENDURANCE IN AN INDIVIDUAL WITH LATE-ONSET POMPE DISEASE AND OSTEOPOROSIS: A CASE REPORT

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BACKGROUND AND PURPOSE: Late-onset Pompe disease (LOPD) is an inherited, progressive muscular wasting disease that commonly affects skeletal and respiratory muscles. Traditional physical therapy interventions employ submaximal aerobic and muscle strength training using land-based approaches. Patients with other degenerative muscle diseases have benefited from training in antigravity, but to date the effects of antigravity training have not been examined in patients with LOPD. The purpose of this case report is to investigate the functional effects of long-term combined aerobic and strength training performed in an antigravity environment in a patient with adult-onset Pompe Disease and osteoporosis.

CASE DESCRIPTION: The patient highlighted in this case was a 65-year-old man with LOPD and osteoporosis who participated in a 52-week aerobic and strength training performed in an antigravity treadmill that was successful in safely increasing functional outcomes. This case report describes a long-term aerobic and strength performed in an antigravity treadmill that was successful in safely increasing functional outcomes in a patient with LOPD.


OP095

APPLICABILITY OF BLOOD FLOW RESTRICTION TRAINING IN PHYSICAL THERAPY PRACTICE: A SYSTEMATIC REVIEW OF THE LITERATURE

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PURPOSE/HYPOTHESIS: The purpose of this review was to assess the applicability and effectiveness of blood flow restriction training in various physical therapy clinical populations.

NUMBER OF SUBJECTS: Not applicable.

MATERIALS/METHODS: A comprehensive search was performed using PubMed, Scopus, Medline, and Google Scholar databases. Search terms included: “Blood Flow Restriction” OR “KAATSU” OR “Vascular Occlusion” AND “Training,” years 2007 to 2017. This review targeted randomized control trials and clinically relevant populations. Sackett (2000) ratings and MacDermid (2004) ratings were used to determine inclusion for this review (0-48 scale). At least 2 reviewers rated each article and discrepancies in scores were reviewed by all authors to achieve consensus for a final score.

RESULTS: Eleven articles met our rigid standards for inclusion in this review (Sackett level of evidence: 1b (n = 9) and 2b (n = 2). MacDermid scores ranged from 38 to 45, with a mean of 41. The clinical populations included were healthy older adults (n = 3), osteoporosis (n = 1), knee osteoarthritis (n = 3), knee arthroscopy (n = 1), anterior cruciate ligament reconstruction (n = 1), and cardiovascular pathology (n = 2).

CONCLUSIONS: Compared to low-intensity exercise without blood flow restriction (LI) groups, low-intensity exercise with blood flow restriction training (LI-BFR) elicited greater improvements in muscle strength and functional outcomes, while not significantly altering hemodynamic response and decreasing subjective pain levels during exercise in some populations. Compared to high-intensity exercise, LI-BFR elicited equal or slightly improved muscle strength. Additionally, results suggest that LI-BFR is safe across many clinical populations.

CLINICAL RELEVANCE: LI-BFR is a relatively inexpensive and effective ad-junctive exercise modality that can be applied to a wide array of populations who may not tolerate or are not cleared for high-stress or high-load exercises. Additionally, as long as recommended application procedures are followed, BFR can be implemented in established traditional, low-load rehabilitation protocols and shows evidence of improved outcomes such as muscle strength and function.
ABSTRACT

BACKGROUND AND PURPOSE: Scis in Sib With Anterior Cruciate Ligament (ACL) Injuries: A Case Series

OP096

A COMPARISON OF THE KINETICS AND KINEMATICS OF CONVENTIONAL AND POWERED (MICROPROCESSOR) ANKLE-FOOT PROSTHESSES DURING LEVEL-GROUND, STAIR, AND RAMP AMBULATION: A SYSTEMATIC REVIEW

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PURPOSE/HYPOTHESIS: Following a transtibial amputation, many individuals struggle to relearn proper gait kinetics and kinematics while using a prosthetic device. Commonly, the first prosthesis given to transtibial amputees includes a conventional ankle and foot system, which can be very rigid and often doesn’t adapt well to varying surfaces. Makers of powered prostheses claim they can increase the patient’s ability to dorsiflex and plantar flex efficiently during normal gait and complex tasks such as ascending and descending stairs or ramps. The aim of this systematic review is to see if powered prostheses offer better kinetics and kinematics when compared to the conventional ankle-foot prosthetics.

NUMBER OF SUBJECTS: One hundred sixteen.

MATERIALS/METHODS: EBSCOhost and Google Scholar were utilized to identify relevant articles related to our question. Seven hundred seventy-one articles were produced utilizing keywords “microprocessor, ankle, foot, transtibial amputee, ambulation” in Google Scholar and “microprocessor feet and and microprocessor ankle” in EBSCOhost. The search was then limited to peer-reviewed articles between 2012 and 2017 and 53 articles were removed. Leaving 53 articles to be screened using the Modified Down’s and Black quality checklist. The powered ankle-foot prostheses compared to the conventional ankle-foot prostheses included improved both kinetics and kinematics during ramp and stair ascent in K2, K3, and K4 level Transtibial amputees. Additionally, the K3 level powered ankle-foot system allowed for improved kinetics, kinematics, and symmetry between extremities during level ground ambulation.

RESULTS: Four articles were rated good and two were fair per the Modified Down’s and Black quality checklist. The powered ankle-foot prostheses improved both kinetics and kinematics during ramp and stair ascension in K2, K3, and K4 level Transtibial amputees. Additionally, the K3 level powered ankle-foot system allowed for improved kinetics, kinematics, and symmetry between extremities during level ground ambulation.

CONCLUSIONS: With the proper training, powered ankle-foot prostheses should be used for K2 level users and above due to the increase in active dorsiflexion during swing and the force generated during stair and ramp ascent. Furthermore, a powered ankle-foot prosthesis improves the patient’s gait kinematics and kinetics during ambulation on level ground through the generation of greater range of motion and power.

CLINICAL RELEVANCE: Powered (microprocessor) ankle-foot prostheses should be considered for K2+ level amputees in order to improve kinetics and kinematics of gait during level ground, stair and ramp ambulation. These improvements may help decrease other body structure and function impairments that tend to arise over time with prosthetic use.

CASE DESCRIPTION: Two sibling participants (1 male, 1 female), each with ACL injuries (one with an ACL tear and the other with a tibial eminence avulsion of the ACL), were recruited. Prospective data included: performance on the Lower Extremity Functional Scale (LEFS), Lysholm Knee Score (Lysholm), Noyes Functional Hop Test; bilateral strength of the lower extremities using dynamometry; knee range of motion measured bilaterally via goniometry; anterior tibial translation laxity via KT-1000 Arthrometer; and the Biodex isokinetic strength testing for bilateral quadriceps and hamstrings at 60°/s, 180°/s, and 300°/s. Retrospective data included radiologic data from the time of injury, including: femoral notch width, notch shape, and tibial plateau slope. The investigators also gathered: date of the injury, age, body mass index (BMI), height, body weight, mechanism of injury, and dominant lower extremity at the time of the injury.

OUTCOMES: In regards to the risk factors for injury observed in the retrospective review, both siblings had decreased femoral notch width and notch Type A in common. Each sibling demonstrated slightly increased strength post injury/rehabilitation on the affected lower extremity, except in 1 muscle group, but this group varied between the 2. For functional hop testing, both siblings scored below the 90% of uninvolved score which is ideal; however, interestingly both performed best in the crossover hop component which is typically considered the most difficult to perform. LEFS scores were high in both siblings and not significantly different as observed via minimal detectable change. In addition, the siblings were within ±5° of knee flexion when comparing ipsilateral sides. Biodex results demonstrated significant deficits at all 3 speeds extension for both siblings. Motion analysis of functional movements observed abnormal movement patterns in both siblings, including a hesitancy to load the affected extremity with cutting, and abnormal landing patterns in landing.

DISCUSSION: The most significant similarities were noted in notch shape and width. In addition, the siblings had similarities in LEFS, strength, extension isokinetic testing, movement patterns, postoperative ROM, and functional hop testing. Future research should focus on larger sample sizes of sibling groups looking at these same risk factors and postoperative/postrehabilitation measures in order to determine which similarities are most common. In addition, notch width and type should be studied in larger groups to determine possible inheritance/genetic link.

CONCLUSIONS: It was not possible to derive a relationship between whiplash and subsequent fibromyalgia diagnosis from this investigation. The encountered EMR infrastructure was not conducive for a retrospective data analysis nor was it successful in creating a cohesive summary of patient encounters across a variety of practitioners. Qualitative and quantitative factors of chronic pain were inconsistently documented in subjective information leading to a lack of common language. Furthermore, there was little consistency in the use of validated outcome measures for either diagnosis.

CLINICAL RELEVANCE: As EMR evolves, automated data gathering algorithms could enhance the collection of meaningful clinical data and prompt the use of a core set of standardized outcome measures for chronic pain conditions. Such infrastructure could improve extraction of meaningful data and develop more informed interdisciplinary management strategies for patients with chronic pain.

OP099

COMPARING HIGH VELOCITY, LOW AMPLITUDE DISTRACTION MANIPULATION FORCES BETWEEN PHYSICAL THERAPY STUDENTS AND EXPERT CLINICIANS

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PURPOSE/HYPOTHESIS: High velocity, low amplitude (HVLA) manipulations have been proven effective in increasing range of motion and decreasing pain in the talocrural joint, atlando-occipital (AO) joint, and hip joint. It has been reported that students are not able to perform specific techniques, such as cervical traction, as accurately as expert clinicians. Further research has been recommended to describe the disparity between students and expert clinicians. This study compared the amount of manipulation force, pretension force and time to peak force applied during distraction manipulations for both expert clinicians and students. Secondary purpose was to determine the test-retest reliability measurements of the Primus Baltimore Therapeutic Equipment (BTE) for manipulation parameters previously stated. The null hypothesis is there will be no significant difference between expert clinicians and students. A second hypothesis is test-retest reliability measurements on the (BTE) will have good to excellent reliability.

NUMBER OF SUBJECTS: Thirty-five.

MATERIALS/METHODS: Thirty-five participants, 20 student physical therapists (10 male, 10 female) and 15 expert clinicians (8 male, 7 female), performed the above three manipulations on 1 investigator prior to testing. Five repetitions of each manipulation were repeated on the BTE. Participants formed the above 3 manipulations on 1 investigator prior to testing. Five participants returned 2 to 14 days later to assess test-retest reliability.

RESULTS: Test-retest reliability was found to be excellent (ICC1,2 = 0.81-0.96) on all manipulation parameters tested (P < .01). Overall, expert physical therapists demonstrated significantly more AO preload forces (P < .01), AO peak force (P < .01) and hip preload forces (P < .05) than students. Overall males had significantly more force and less time to peak force for all manipulations except AO time to peak force (P < .01). CONCLUSIONS: The BTE is a reliable test to measure manipulation forces and velocity. The current study is in agreement with previous studies showing significant difference in spinal preload forces and peak forces between students and expert clinicians. Extremity manipulations, except for hip preload force, didn’t demonstrate difference between students and expert clinicians as reported with spinal manipulations. An unexpected result was the difference between male and female manipulation parameters but is in agreement with previous manual therapy studies.

CLINICAL RELEVANCE: Students produce less force than expert clinicians when performing spinal manipulations but do not differ in extremity manipulations. This could be due to less fear of causing injury in the extremities. The
difference between male and female manipulation parameters need to be further investigated. The BTE is a reliable test to measure manipulation parameters and can be used as a training and testing tool for manipulators.

**OP0100**

**FEASIBILITY OF QUANTITATIVE T2*-MRI TO MONITOR ACCELERATED DISC DEGENERATION IN INDIVIDUALS WITH SCOLIOSIS FOLLOWING CORRECTIVE FUSION SURGERY**

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**PURPOSE/HYPOTHESIS:** Accelerated disc degeneration is commonly observed in patients with scoliosis post corrective fusion surgery due to increased stress at the adjacent levels.1 Disc degeneration is associated with a decrease in biochemical and biomechanical properties. The clinical standard, T2-weighted MRI, is subjective.2,3 While, T2* MRI sequence is objective and has been shown to relate to these properties; however, this sequence is subject to metal interference.4,5 The aim of this study was to quantify metal artifact associated with spinal instrumentation to assess the feasibility of using T2* for evaluating degeneration.

**NUMBER OF SUBJECTS:** Seven ex vivo immature porcine lumbar segments.

**MATERIALS/METHODS:** Subjects were imaged using a Siemens 3T MRI scanner (MAGNETOM Prisma; Siemens Health care) where T2-weighted and T2 maps were acquired using these input parameters: TR (ms), 3220; TE (ms), 91; voxel size (mm), 0.47 × 0.47 × 3.2; slices, 33; and TR (ms), 500; TE (ms), 4.18, 11.32, 18.46, 25.6, 32.74, 39.88; voxel size (mm), 0.47 × 0.47 × 3.2; slices, 33. Scans were taken of each segment adjacent and post instrumentation that included: 2 pedicle screws (T1), 2 set screws (T1), and 2 rods (CoCy). A custom MATLAB script (MathWorks, Inc) was used to identify the nucleus pulposus, and mean T2* relaxation times were recorded at the adjacent and subjacent discs (caudal to pedicle insertions). Three Student t tests were carried out between adjacent and subjacent discs prior to instrumentation, and between prior and post instrumentation at both levels. The minimum distance from the adjacent disc to the pedicle screw was measured via OsiriX Imaging Software. Pearson correlation test was performed between implant noise and minimum distance.

**RESULTS:** T2* relaxation times were not statistically different between adjacent and subjacent discs prior to instrumentation (P = .75). Subjacent disc’s T2* relaxation time was not affected by instrumentation (P = .23), but a significant difference was observed at the adjacent disc (P = .002). Adjacent disc distance had a negative correlation with change in T2* signal (r = −0.57, P = .18).

**CONCLUSIONS:** There was a decrease in T2* signal at the adjacent disc with an average distance of 1.88 cm between the disc and instrumentation. While, the T2* signal at the subjacent disc located at an average of 5.52 cm from the instrumentation and was not significantly altered. Since the T2* signals were similar prior to instrumentation at the adjacent and subjacent discs, the decrease in T2* signal at the adjacent disc may be due to the disc’s proximity to spinal instrumentation.

**CLINICAL RELEVANCE:** Major changes in T2* signal occurred within 2 cm, which is closer than clinically observed. Patients with scoliosis are at an increased risk for accelerated disc degeneration, which with early diagnosis provides better chances for therapy. Proper utilization of the T2* sequence post-surgical intervention may provide insight on their disc degeneration, given adequate distance away from the spinal instrumentation.

**FOR FUTURE RESEARCH**

Future work will include investigating this relationship in other movement tasks in a larger sample.

**OP0102**

**POTENTIAL EFFECTS OF TRANSCUTANEOUS ELECTRICAL NERVE STIMULATOR ON LONG-TERM PERIPHERAL HYPOALGESIA IN SYMPTOMATIC TRIGEMINAL NEURALGIA: A CASE STUDY AND PROPOSAL FOR FUTURE RESEARCH**

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**BACKGROUND AND PURPOSE:** Transcutaneous Electrical Nerve Stimulator (TENS) has been suggested to offer hypalgesia effects in patients with nonspecific chronic musculoskeletal and neuropathic pain. This study considers a potential case of persistent neuromodulation at the level of the trigeminal nerve after accidental high-intensity discharges by a TENS stimulator on long-term peripheral hypoalgesia in a patient with trigeminal neuralgia (TN). This study will also propose considerations for research on variable use of TENS in the management of TN.

**CASE DESCRIPTION:** A 53-year-old man with a medical diagnosis of migrainous headaches presented with chronic neck pain, intermittent left-sided facial lancinating pain and persistent soreness at bilateral supraorbital and suborbital regions of the face following a bilateral upper third molar extraction in 2015. Based on subjective history, objective assessment and the International Headache Society (IHS) classification system, the pa-
tient was diagnosed with symptomatic TN and cervicogenic headaches.

OUTCOMES: Evaluation of functional restriction was completed at his initial appointment with a Neck Disability Index (NDI) score of 60%. The visual analog scale (VAS) was used to assess the patient’s perceived level of facial pain at it’s worst (8/10) and it’s best (2/10). The patient was seen for fourteen 60-minute sessions; on the eighth visit the patient was given a TENS unit for home management of his facial pain. TENS parameters were: pulse width 150 microseconds, pulse rate 100 Hz and 0.5-second cycle time at tolerable intensity. After 8 sessions focusing on management of cervical facet and temporomandibular joint dysfunction, the patient reported having a VAS score of 6/10 (worst) and 1/10 (best). At his 10th visit the patient reported having 4/10 (worst) and 0/10 (best) immediately following several user-related accidental high-intensity discharges (54 mA) from his TENS unit. At his 14th visit the patient’s VAS score was 4/10 (worst) and 0/10 (best) and the NDI was 30%, both of which reflect minimal clinically important differences.

DISCUSSION: VAS, NDI, as well as frequency, duration and intensity of neck pain and headaches significantly improved through therapeutic interventions. These outcomes suggest that the inclusion of high-intensity discharge TENS may cause prolonged hypoalgesia at the level of the ophthalmic and maxillary branches of the trigeminal nerve. Treatment correcting cervical facet and jaw dysfunction also offered benefits early in this patient’s plan of care. Future research should assess the use of high-intensity discharge TENS in conjunction with cervical and jaw treatments to ascertain therapeutic outcomes in patients suffering from TN. A case-series and a randomized control trial may allow for comparison of short and long-term benefits of TENS, as well as variable settings and application of TENS in the management of both classical and atypical TN.

CONCLUSIONS: All MST participants who had previously received PT indicated MST was different from prior treatment, while about half of SF participants indicated SF was different. These findings suggest a potential lack of exposure to MST, which may explain why initial ratings of MST were lower compared to SF. Based on our findings, attribute ratings appear to be modifiable: 3 MST attribute ratings improved 1 year post-treatment, while 2 SF attribute ratings worsened.

CLINICAL RELEVANCE: Assessing a patient’s treatment attribute ratings provides the clinician with information about the patient’s perceptions of the treatment options proposed. A patient may rate 1 treatment lower than another; however, the clinician may think the lower-rated treatment is an appropriate treatment to provide. Educating and exposing the patient to that treatment, specifically addressing the attributes the patient rated low, may enhance the patient’s perception of that treatment.

OP0104
TESTING POSITION VARIABILITY WITH UPPER EXTREMITY NEURODYNAMIC TESTS
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PURPOSE/HYPOTHESIS: Tests of neurodynamic function are used in the upper extremity to examine patients with neuromusculoskeletal movement dysfunction. While these tests are routinely completed in the non-weight-bearing supine position, minimal data exists regarding testing in the weight-bearing seated position. The purpose of this study was to determine if position influences upper extremity neurodynamic function and assessment.

NUMBER OF SUBJECTS: The study included a total of 50 asymptomatic subjects; 36 were female and an age range of 21 to 46 years old for the entire sample (mean ± SD age, 23.7 ± 3.55 years).

MATERIALS/METHODS: Each subject signed a consent and provided demographic information consisting of age, gender, hand dominance, prior cervical spine or shoulder girdle dysfunction, and recent upper quarter surgery information. Each subject completed a series of tests measuring cervical range of motion (ROM), and neurodynamic testing using standardized procedures. The neurodynamic tests included median, ulnar, and radial nerves bilaterally. Neurodynamic dysfunction was identified as abnormal responses short of complete range of motion for the last stage of the neural limb tension tests of the median (elbow extension), ulnar (shoulder abduction), and radial (elbow extension) as described by Butler. The neurodynamic tests were done in supine and seated. One examiner assessed the supine position while the second examiner the seated position. To determine reliability each examiner performed the tests in both positions. Interrater reliability was demonstrated using a t test for a paired sample. There was no significant differences between the 2 examiners for either position.

RESULTS: A paired-samples t test was calculated to compare the mean seated score to the mean supine score. The median and radial nerves demonstrated more dysfunction in the non-weight-bearing supine position (median tM = 5.726, P = .000; radial tM = 3.398, P=.001). The ulnar nerve did not demonstrate significant differences in either the supine or seated positions (tM = 0.121, P=.094).

CONCLUSIONS: The median and radial nerves appear sensitive to patient position. The non-weight-bearing supine position identified greater loss of range of motion than the weight bearing position of seated. However, position is not a factor in assessing the neurodynamic function of the ulnar nerve.

CLINICAL RELEVANCE: Productive intervention of movement dysfunction is directly related to the depth and breadth of information collected during the examination. Data from multiple systems is important for a comprehensive understanding of each systems role and interactions related to the movement dysfunction. Neurodynamic examination of the upper extremities is important with any upper quarter movement dysfunction diagnosis. Understanding the implications of patient position from which to acquire the most valid information is critical. Being able to differentiate the position most likely to provide insight of actual loss of function for the median, ulnar, and radial nerves provides a basis for efficient intervention.

OP0105
MANUAL PHYSICAL THERAPY AND CERVICAL JOINT POSITION TRAINING FOR CERVICOGENIC DIZZINESS FOLLOWING WHIPLASH-ASSOCIATED DISORDER: A CASE REPORT
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BACKGROUND AND PURPOSE: Whiplash is defined as an acceleration-deceleration injury to the neck, which may lead to a variety of immediate and/or prolonged symptoms collectively known as whiplash-associated disorder (WAD). Cervicogenic dizziness is one possible sequela that may arise from dysfunction within the structures of the cervical spine, disrupting the flow of sensory and proprioceptive feedback. The purpose of this case report is to demonstrate the efficacy of combining manual physical therapy and cervical joint position training on a patient with cervicogenic dizziness status-post motor vehicle accident (MVA).

CASE DESCRIPTION: A 28-year-old woman with a history of MVA and chief complaint of a 1-month history of progressive increase in left-sided headache and dizziness was referred to physical therapy from her primary care physician with a diagnosis of Benign Paroxysmal Positional Vertigo (BPPV). Physical therapy evaluation revealed impairments including cervical joint mobility deficits, cervical joint position sense error, muscle imbalances and decreased neuromotor control. Functional limitations included difficulty with looking up and down, working on the computer, and carrying her child. At the time of initial evaluation, the frequency of symptoms was reported as a minimum of 4 days a week, for 75% of the day. The patient was seen 2 times per week for 3 weeks for a total of 6 sessions. Interventions included manual therapy, cervical joint proprioception training, cervicospinal stabilization, and therapeutic exercise including a home exercise program.

OUTCOMES: Numeric pain-rating scale (NPRS) values improved from 5/10 to 0/10, Dizziness Handicap Inventory (DHI) scores significantly improved from 32/100 to 2/100, and Cervical Joint Position Error decreased to below the meaningful error value at the time of discharge. The patient reported no headaches or dizziness for 10 days prior to discharge and denied limitations in function.

DISCUSSION: This case report supports the use of physical therapy intervention, including cervical joint position training and manual physical therapy, in the treatment of patient status-post MVA with cervicogenic dizziness.


OP0106 HIPOSTEROLATERAL MUSCULATURE STRENGTHENING IN PATIENTS WITH CHRONIC NONSPECIFIC LOW BACK PAIN: PRELIMINARY RESULTS OF A RANDOMIZED CLINICAL TRIAL

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PURPOSE/HYPOTHESIS: Chronic nonspecific low back pain is an important health condition with a high prevalence worldwide and it is associated with enormous direct and indirect costs to the society. Clinical practice guidelines show that many interventions are available to treat patients with chronic low back pain, but the vast majority of these interventions have a modest effect in reducing pain and disability. A biomechanical approach that has been raised is that a weakness of the hip abductors, extensors, and lateral rotators musculature would lead to excessive contralateral pelvic drop during weight-bearing activities, generating an overload in the lumbar area. Although the strengthening of the hip muscles is largely used in clinical practice for treating patients with hip and knee injuries, there is still a lack of evidence regarding patients with low back pain. The purpose is to determine the efficacy in terms of functional improvement, pain relief, strength, and kinematics variables of the hip strengthening in patients with chronic nonspecific low back pain who receive conventional physical therapy.

NUMBER OF SUBJECTS: Twenty-four.

MATERIALS/ METHODS: Twenty-four patients were initially assessed by validated questionnaires, clinical and functional tests, hand-held dynamometry of the involved muscles, and gait analysis with a 2-D system. The subjects were randomized to receive 10 treatment sessions over a period of 5 weeks based on the principles of conventional physical therapy, which consisted of a combination of manual therapy techniques and exercises for spinal segmental stabilization (control group) or to receive conventional physical therapy plus the addition of hip strengthening (hip group). Pain intensity, functional status, strength, and frontal plane kinematics (trunk, pelvis and hip) during gait were collected at baseline and at 5 weeks after randomization. Data were collected by a blinded examiner who was unaware about the group allocation.

RESULTS: The intragroup analysis showed that both presented improvements in pain and function (Numerical Pain Rating Scale and Rolland Morris questionnaire) in the posttreatment evaluation when compared to baseline (P<.05). The hip group presented increase in muscle strength (P<.05) and tendency to pain decrease (P=.06) in the posttreatment evaluation when compared to the control group. However, there was no significant difference between groups for function and kinematic variables, ie, trunk lean, pelvic drop and hip adduction.

CONCLUSIONS: The preliminary findings suggest that the addition of hip strengthening may be of clinical value in terms of pain relief and strength but do not appear to result in improved function and lower limb kinematics in patients with low back pain.

CLINICAL RELEVANCE: The results of this study may help in the decision making of physical therapists, including hip strengthening in traditional protocols, as well as may reduce the enormous costs associated with chronic nonspecific low back pain.

OP0107 LOW-LOAD, LONG-DURATION STATIC STRETCH DURING PREFREEZING PHASE OF ADHESIVE CAPSULITIS

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BACKGROUND AND PURPOSE: Adhesive capsulitis (AC) is both a painful and functionally debilitating shoulder condition characterized by decreased active and passive range of motion (ROM). The condition has been described as self-limiting, typically resolving in 1 to 3 years, with long-term ROM deficits lasting up to 10 years.1 This is reported to affect 2.35% to 5% of the general population.2 AC is categorized into 4 phases: pre-adhesive phase (prefreezing, 1-3 months), painful phase (freezing, 3-9 months), stiff phase (frozen, 9-14 months) and resolution phase ( thawing, 12-15 months).3 There is sufficient research to support the use of low load, long duration stretching,4,5 during the freezing phase of AC. There is very limited evidence utilizing this treatment concept in the preadhesive phase of AC. While maintaining this theory that the low load, long duration treatment is beneficial for the freezing phase of AC, the purpose of this case report is to examine the efficacy of low load, long duration during the prefreezing phase of the AC progression.

CASE DESCRIPTION: The patient’s past medical history was reviewed and was insignificant. The patient was referred by her orthopaedic surgeon for early AC. The functional outcome measures utilized were the Disabilities of the Arm, Shoulder and Hand (QuickDASH) and the 11-point numeric pain rating scale (NPRS). The QuickDASH has been shown to have good test-retest reliability and construct validity.6 Both the NPRS and QuickDASH have demonstrated to be a reliable pain scale for patients with shoulder dysfunction.6 QuickDASH score was 52.27 and NPRS was 0/10 at its lowest and 8/10 at its worst. Symptoms were exacerbated with activities requiring her reach above shoulder height and she also has difficulty reaching behind her back. Initial active range of motion (AROM) measurements are as follows: flexion 88°, abduction 86°, internal rotation (IR) 60° and exter-
nal rotation (ER) 51°. Strength measurements ranged from 2+/5 to 3−/5. The focus of treatment included supine static shoulder flexion and sidelying shoulder abduction, while holding a 1-lb weight for 30 seconds and progressed up to 120 seconds, per patient tolerance. Once this was tolerated resistance was increased and the process was restarted.

OUTCOMES: The patient was seen for a total of 17 visits over the course of 21 weeks. The patient was able to achieve all functional goals and symptoms had decreased to 0 to 1/10 symptoms with activity. AROM is as follows: flexion, 167°; abduction, 164°; IR, 74°; and ER, 85°. Strength improved to grossly 4+/5, in all planes. The QuickDASH score had decreased from a 52.27 at evaluation to 22.73 at discharge follow-up. This is a score improvement of 29.54. Three months following discharge the QuickDASH score was 4.55. The minimal clinically important difference (MCID) on the QuickDASH has been reported to be an 8-point change.4

DISCUSSION: The implementation of a low load, long duration intervention during the prefracturing phase of AC was effective in improving function and decreasing symptoms.


OP0109

DERIVATION OF A CLINICAL ESTIMATE OF ACHILLES TENDON LOAD DURING RUNNING

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PURPOSE/HYPOTHESIS: Achilles tendon injuries are one of the most common injuries in running and sports, particularly among males. High tendon loads provided without sufficient time for adaptation are associated with Achilles tendon injury. However, clinical methods to quantify Achilles tendon loads have not been developed. Such methods may improve Achilles tendon injury prevention and treatment efforts. The purpose of this study was to derive and test a set of clinical gait measurements to (1) estimate Achilles tendon load during running and (2) screen for runners with high Achilles tendon impulse.

NUMBER OF SUBJECTS: Thirty-seven recreationally active males (23.5 years old).

MATERIALS/METHODS: Synchronized 2-D (100 Hz) and 3-D (200 Hz) lower extremity kinematics and ground reaction forces (1000 Hz) were recorded during preferred speed running (2.9 m/s). Three-dimensional data were input to a biomechanical model to estimate Achilles tendon force impulse over 5 stance phases. A stepwise multiple linear regression was used to identify the smallest set of 3-D kinematic and temporal-spatial variables that best predicted Achilles tendon impulse. Two-dimensional surrogate measurements of these 3-D predictor variables obtained via open source software were then tested using multiple linear regression to establish the accuracy of 2-D video measurements to estimate Achilles tendon impulse (R^2 and 95% CI of the prediction). Logistic regression was used to test the predictive validity (+LR) of 2-D video measurements to screen for runners with Achilles tendon impulse values in the top quartile of all participants.

RESULTS: Mean Achilles tendon impulse during preferred speed running was 0.73 (±0.13) BW-s. 3-D predictors including ankle dorsiflexion excursion, swing phase time, stance phase time, and vertical excursion of the center of mass accounted for 70% of the variability in Achilles impulse determined using the biomechanical model (R^2 = 0.70, P<.001; 95% CI:
The patient underwent emergency surgery for L1 laminectomy with tumor resection. The tumor was found to be benign, and the patient had full resolution of symptoms.

**DISCUSSION:** PT can help improve pain and function in patients with mechanical LBP with and without UI. However in the case of failed conservative management with the presence of red flags, a referral to the patient’s PCP is warranted for further medical work-up to identify other serious spinal pathology causing the patient’s pain.

PEAR TO BE DRIVEN BY LACK OF INTEREST. WHEREAS LACK OF TIME, SPACE, FINANCIAL RESOURCES, UNWILLING OR UNCOOPERATIVE COACHING STAFF OR PARENTS, AND DISINTEREST FROM STUDENT-ATHLETES WERE REPORTED TO BE SIGNIFICANT BARRIERS TO CLINICAL IMPLEMENTATION OF ACL IPPS.

CONCLUSIONS: MOST PTs ENCOURAGED THE USE OF ACL ARPs AND IPPS, YET NEARLY ONE THIRD REPORTED DISCHARGING ATHLETES PRIOR TO PROGRESSING ATHLETES TO RUNNING, AGILITY, OR SPORT-SPECIFIC ACTIVITIES.

CLINICAL RELEVANCE: ACL ARPs HAVE POTENTIAL TO IMPROVE CLINICAL OUTCOMES AND RETURN TO SPORT RATES IN AN ATHLETIC POPULATION, BUT ATTITUDE BARRIERS SHOULD BE ADDRESSED TO ENSURE WIDESPREAD UTILIZATION. SIMILARLY, ACL IPPS HAVE POTENTIAL TO REDUCE INJURY INCIDENCE ON A POPULATION LEVEL, BUT LOGISTICAL BARRIERS SHOULD BE ADDRESSED TO ENSURE WIDESPREAD UTILIZATION AND COMPLIANCE.

OP0113

CLINICAL DECISION MAKING IN THE EVALUATION AND MANAGEMENT OF AN ELITE FEMALE GYMNAST WITH A HAMSTRING STRAIN AND UNDERLYING ADVERSE NEURAL TENSION

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BACKGROUND AND PURPOSE: GYMNASTICS IS A HIGH DEMANDING SPORT REGARDING THE LEVEL OF FLEXIBILITY AND COMPLETE BODY RECRUITMENT COMPARED TO OTHER SPORTS, AND PRESENTS A UNIQUE DIAGNOSTIC AND TREATMENT CHALLENGE TO PHYSICAL THERAPISTS.1 FRONT SPLITS OR KICKS CAN CAUSE HAMSTRING INJURIES DURING FAST OR SLOW MOVEMENTS INVOLVING SIMULTANEOUS HIP FLEXION AND KNEE EXTENSION, AND PLACE THE ATHLETE IN VULNERABLE POSITIONS RISKING NERVE INJURY.2,3 ADVERSE NEURAL TENSION CAN BE COUPLED WITH POSTERIOR THIGH PAIN AND DETECTED WITH THE SLUMP TEST, WHICH CAN BE POSITIVE DUE TO RESIDUAL INFLAMMATION AND SCARRING.4 WHILE THE NERVOUS SYSTEM CAN ADAPT TO A VARIETY OF RANGES AND SPEEDS BIOMECHANICALLY, THE RELATIONSHIP BETWEEN MUSCLE STRAINS AND ADVERSE NEURAL TENSION IS THEORETICAL AT BEST.5 WITH THE NERVOUS SYSTEM IN ATHLETES WITH STRAIN INJURIES OVERLOOKED, THE PURPOSE OF THIS CASE REPORT IS TO BRIDGE THE GAP BETWEEN HAMSTRING STRAINS AND ADVERSE NEURAL TENSION DURING FRONT SPLITS IN AN ELITE GYMNAST.6


OUTCOMES: FUNCTIONAL SELF-RATING SCORING AT 4 WEEKS IMPROVED BY 70% WITH RFS JUMPS AND 90% WITH FLOOR RFS. AT 8 WEEKS, 100% IMPROVEMENT IN FLOOR AND JUMP RFS REPORTED. AFTER IMPLEMENTING NEURAL FLOSSING, PATIENT PERFORMED RFS PAIN FREE.

DISCUSSION: WHEN EVALUATING HIGH LEVEL ATHLETES SUCH AS GYMNASTS WITH HAMSTRING STRAINS, IT MAY BE BENEFICIAL TO INCORPORATE THE SLUMP AND SLR TESTS TO DETECT UNDERLYING ADVERSE NEURAL TENSION. EVALUATING NEURAL MOBILITY WITH HAMSTRING INJURIES MAY IMPROVE FUNCTIONAL OUTCOMES WHEN RETURNING GYMNASTS TO POSITIONS THAT REQUIRE A SIGNIFICANT DEGREE OF FLEXIBILITY.

Three females aged greater than 60 years old were tested to patients with LLDs. For older adults (older than 60 years), low back pain (LBP) is a prevalent condition that is associated with disability. Considering this, it is reasonable to expect that many older adults treated by physical therapists for conditions of the upper quarter would simultaneously experience disabling LBP. In light of our current understanding of regional interdependence, lumbar impairments could also affect functional progress in the rehabilitation of upper quarter conditions. Therefore, the purpose of this case series is to describe the management of LBP in a population of older adults presenting with primary complaints in the upper quarter.

**CASE DESCRIPTION:** Three females aged greater than 60 years old were treated in an outpatient physical therapy clinic with primary complaints occurring in the upper quarter. During the course of their treatment, LBP surpassed the initial chief complaint as the factor most limiting to function with activities of daily living (ADLs). After clinical assessment, the patients were treated with manual therapy techniques and exercises for the lumbar spine to enhance upper quarter function.

**OUTCOMES:** Treatment episodes for a mean duration of 20.3 visits over an average of 16 weeks. Two of the 3 patients achieved clinically-meaningful improvements in pain (measured by numeric pain-rating scale), and 2 moved from moderate physical function to high physical function (based on the abbreviated Activities-specific Balance Confidence scale). All patients reported improved tolerance to standing to perform ADLs after intervention with activities of daily living (ADLs). After clinical assessment, the patients reported improved tolerance to standing to perform ADLs after interventions directed to the lumbar spine.

**DISCUSSION:** The impact of regional interdependence on orthopaedic conditions should drive clinicians to assess adjacent and nonadjacent regions of the body when formulating a plan of care. In this case series, interventions directed to the lumbar spine were applied to enhance progress toward functional goals in a population of older adults with primary complaints.

**OP0114**

**REAL-TIME ULTRASOUND IMAGING ASSESSMENT OF THE PIRIFORMIS DURING VARYING DEGREES OF HIP FLEXION**

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**PURPOSE/HYPOTHESIS:** Real-time ultrasound imaging (RTUSI) was utilized to investigate the role of the piriformis (PF) in the neutral position and at greater than 90° of hip flexion (FLX) and in a stretch position by Kendall. Direction of muscle fiber movement and muscle thickness changes were considered by collaborative discussion among 3 blinded investigators to determine whether the PF was shortening or lengthening in each test position.

**RESULTS:** The results of the 4 active tests were: at 0° of hip FLX, 97% shortened with ER and 85% lengthened with IR; at 110° of hip FLX, 67% lengthened with ER and 94% lengthened with IR. During the passive Kendall stretch 9% lengthened.

**CONCLUSIONS:** At 0° of hip FLX the PF shortened with ER and lengthened with IR. There were variable results among subjects for ER at 110° of FLX; therefore, we can neither support nor refute that the PF is an IR at ranges greater than 90° of hip FLX. However, in IR at 110° of FLX, the PF lengthened implying that it was being stretched, refuting that the PF is an IR at ranges greater than 90° of hip FLX. Hip FLX and hip ADD are the primary movements required for optimal muscle lengthening of the PF. In addition, analysis of femoral morphology should be analyzed in subjects when assessing the role of the PF, as it may have an integral impact on the action of the muscle.

**CLINICAL RELEVANCE:** These results suggest that the PF has variable muscle actions in regard to IR and ER. To maximally stretch the PF, hip FLX and ADD must be performed with both IR and ER to accommodate for variations among subjects.

**OP0115**

**THE EXPERIENCES OF ADULT-ORIENTED PHYSICAL THERAPISTS PROVIDING SERVICES FOR INDIVIDUALS WITH LIFELONG DISABILITIES**

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**PURPOSE/HYPOTHESIS:** The life expectancy for persons with lifelong disabilities (LLDs) has increased due to improved living conditions, development of antibiotics, and advancements in technology. As the lifespan of this population increases, so too have the impairments occurring as a result of overuse of an already compromised musculoskeletal system. Persons using abnormal movements since childhood are prone to overuse injuries, arthritis and chronic pain into their adult years. Young adults with LLDs often have restricted access to general and specialty health care. There is also a corresponding lack of knowledge by adult health care providers, including physical therapists (PTs), about the needs of this population with LLDs. The purpose of this study is to explore the perceptions and experiences of adult-oriented PTs as they are providing services to patients with LLDs.

**OP0116**

**IMPAIRMENT-BASED INTERVENTION DIRECTED TO THE LUMBAR SPINE FOR OLDER ADULTS PRESENTING WITH UPPER-QUARTER PRIMARY COMPLAINTS**

**Michael Gray, Zachary E. Walston, Dale M. Yake**

**PT Solutions Physical Therapy, Kennesaw, Georgia**

**BACKGROUND AND PURPOSE:** For older adults (older than 60 years), low back pain (LBP) is a prevalent condition that is associated with disability. Considering this, it is reasonable to expect that many older adults treated by physical therapists for conditions of the upper quarter would simultaneously experience disabling LBP. In light of our current understanding of regional interdependence, lumbar impairments could also affect functional progress in the rehabilitation of upper quarter conditions. Therefore, the purpose of this case series is to describe the management of LBP in a population of older adults presenting with primary complaints in the upper quarter.

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**DISCUSSION:** The impact of regional interdependence on orthopaedic conditions should drive clinicians to assess adjacent and nonadjacent regions of the body when formulating a plan of care. In this case series, interventions directed to the lumbar spine were applied to enhance progress toward functional goals in a population of older adults with primary complaints.
plants in the upper quarter. Further studies are needed to determine the efficacy of such an approach.


OP0117
EXPLANATORY MULTIVARIATE MODELING FOR DISABILITY, PAIN, AND CLAIMS IN PATIENTS WITH SPINE PAIN TREATED IN A DIRECT-ACCESS PHYSICAL THERAPY MODEL OF CARE
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PURPOSE/HYPOTHESIS: Direct-access physical therapy (PT) may result in improved patient outcomes and reduced health care costs. A better understanding of prognostic factors associated with spine-related outcomes and insurance claims under this model of care is needed. Past models did not include patients who received direct access and had variable thresholds in the outcomes. The objectives of this study were to identify factors that predict variations in treatment outcomes for neck and low back pain and insurance claims by patients utilizing direct access PT. We hypothesized that different thresholds in outcomes measures will result in different predictors during modeling.
NUMBER OF SUBJECTS: Two hundred fifty.
MATERIALS/METHODS: This was a retrospective cohort study across 8 outpatient PT clinics. Clinical data from the ATI Patient Outcomes Registry and third party claims data for patients with neck or back pain were analyzed from a 3-year period. Treatment outcomes, based on the Neck Disability Index (NDI) or Oswestry Disability Index (ODI), were classified into 3 levels: High (greater than 10 points), Low (4-10 points), or Did Not Meet (less than 4 points) minimal clinically important difference (MCID) scores. Insurance claims were annualized, then categorized into low, middle, or high tertiles. Prognostic variables were analyzed from baseline patient information and other factors during the episode of care. Bivariate multinomial logistic regression analyses were performed to establish significance for prognostic factors that were then used in hierarchical multivariate multinomial logistic regression models to determine effects on disability and claims.
RESULTS: A total of 40.4% of patients had outcomes classified as High MCID, 42.4% as Low MCID, and 17.2% as Did Not Meet MCID. Females were more likely to meet High MCID (odds ratio [OR] = 2.84; 95% CI: 1.32, 6.11) and Low MCID (OR = 2.86; 95% CI: 1.34, 6.10). Patients with higher initial ODI or NDI scores were more likely to meet High MCID (OR = 1.04; 95% CI: 1.07, 1.12) and Low MCID (OR = 0.91; 95% CI: 0.77, 1.07). The odds of having a high insurance claim were lowered by the absence of imaging (OR = 0.04; 95% CI: 0.02, 0.09), prescription drugs (OR = 0.36; 95% CI: 0.14, 0.18), more passive than active treatment (OR = 0.38; 95% CI: 0.18, 0.80), and seeing a specialist (OR = 0.44; 95% CI: 0.24, 0.82).
CONCLUSIONS: Females and higher initial disability were predictive of favorable treatment outcomes in a direct access PT model of care. The novel introduction of claims into the prognostic modeling supports that active PT interventions and avoiding imaging may reduce claims related costs.
CLINICAL RELEVANCE: Our results support the hypothesis that different predictors are present for high and low thresholds for patient outcomes. If predictive modeling is used to select treatment interventions, it’s important to understand the threshold of the model used.

OP0118
MCMURRAY’S TEST AND ITS MODIFICATIONS: A SYSTEMATIC REVIEW
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PURPOSE/HYPOTHESIS: Current evidence shows meniscal tears are the most common pathology of the knee, affecting approximately 66 out of every 100,000 people.1 In 1928, Thomas Porter McMurray first introduced a test to detect meniscal tears, known today as the McMurray’s test.2 He later modified his original test by adding an extension component to 90°.3 Since, there have been numerous modifications made over the last 90 years without ever comparing their effectiveness to the original McMurray test.4-6 The purpose of this systematic review was to examine the literature in order to compare the effectiveness of the original McMurray’s test to its modified versions. It also established a historical timeline of the McMurray’s test to determine if the results support using modified versions of the test over the original in clinical practice.
NUMBER OF SUBJECTS: Zero. This is a systematic review.
MATERIALS/METHODS: A systematic review of the literature was undertaken and guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. The search engine Google Scholar (US, BR, ES; 2004) and the following databases were searched from the inception of each database to August 2016: Ovid Medline (1992), Proquest Biology (1992), Cochrane (1993), Nursing and Allied Health (1977, on the web 1984), CINAHL (1984), Pubmed (1996), Rehab and Sports Medicine (EBSCO 2000), Proquest Health and Medical Collection (1995), and Sportdiscus (1949). Articles were included for the systematic review based on the following criteria: (1) RCTs from peer reviewed journals, (2) Medical texts and original works in the English, Portuguese, and Spanish languages.
RESULTS: The search yielded a total of 1861 citations, of which only 9 met our inclusion criteria. Modifications to McMurray’s original test were found to include: varus/valgus stress, abduction/adduction, full extension, and compression. Available validity measurements of sensitivity and specificity for all tests reviewed ranged from 48 to 86 and 29 to 94, respectively.
CONCLUSIONS: The results of this systematic review allowed for the formation of a historical timeline of the McMurray’s test, thus permitting a detailed examination of all modifications made to the test over the last several decades. In general, it revealed limitations and lacked consistency about the effectiveness of the various versions of the McMurray’s test. There remains uncertainty about the test’s validity due to the inconsistent manner in which it is performed.
CLINICAL RELEVANCE: This review suggests the McMurray’s test can be a relatively specific and sensitive test used to detect meniscal tears; however, the results of the systematic review emphasize authors using modified versions of the test report inconsistent statistical values. Additionally, the results of this review demonstrate the importance of maintaining consistency when describing and performing the McMurray’s test in order to optimize clinical practices.

OP0119
INSTRUMENT-ASSISTED SOFT TISSUE MOBILIZATION AND PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION TECHNIQUES IMPROVE HAMSTRING FLEXIBILITY BETTER THAN STATIC STRETCHING
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PURPOSE/HYPOTHESIS: Tight hamstrings contribute to decreased efficiency of functional movement, increased risk for injury, and poorer outcomes following orthopaedic surgery. Static stretching is the most common intervention for tight hamstrings. However, the use of alternative interventions such as instrument-assisted soft tissue mobilization (IASTM) and proprioceptive neuromuscular facilitation (PNF) techniques is increasing among clinicians desiring to improve hamstring flexibility. This study examined 2 prospective studies with the common aim of demonstrating the effectiveness of either IASTM or PNF over static stretching for improving hamstring tightness.

NUMBER OF SUBJECTS: Healthy individuals were recruited on the University of South Carolina campus: n = 17 in the IASTM dataset, with 11 males and 6 females (age, 20-30 years; mean ± SD age, 24 ± 2 years) and n = 23 in the PNF data set, with 7 males and 16 females (age, 21-65 years; mean ± SD age, 32 ± 14.2 years).

MATERIALS/METHODS: In both studies, subjects’ baseline bilateral hip flexion range of motion was measured with a straight leg raise test; in the IASTM study a passive straight leg raise (PSLR) was used, while in the PNF study an active straight leg raise (ASLR) was used. Subjects performed a self-static stretch on 1 randomly selected leg and the alternative intervention was performed on the contralateral leg. Post-intervention measurements utilizing the respective straight leg raises were performed. The 2 datasets were analyzed separately for reliability indices and significant differences between interventions.

RESULTS: ICC and SEM indicated good reliability for both studies, and MDC values were small and similar. Both studies showed significant interactions between time and intervention (P < .05 for PNF and P < .001 for IASTM). Follow-up analyses revealed that the PNF and IASTM interventions resulted in more improvement than static stretching interventions.

CONCLUSIONS: These findings demonstrate the effectiveness of PNF and IASTM techniques over static stretching for improving hamstring flexibility. Comparable MDC values between studies indicate the PSLR and ASLR may be similar in their ability to detect change to intervention.

CLINICAL RELEVANCE: Hamstring tightness results in decreased functional efficiency during mobility and increased risk for injury in various clinical populations. Through statistical analysis of 2 emerging alternative interventions, this study provides evidence of their comparative merit as treatment choices and informs clinicians seeking to address the impairment of clinically-shortened hamstrings.

OP0120

IS CALCANEAL QUANTITATIVE ULTRASOUND A VALID SURROGATE MEASURE FOR HIP DUAL-ENERGY X-RAY ABSORPTIOmetry IN YOUNG ADULTS?

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PURPOSE/HYPOTHESIS: Dual energy X-ray absorptiometry (DXA) is the gold standard for assessing bone mineral density (BMD) and osteoporotic fracture risk in older adults. While adolescents and young adults have low rates of osteoporotic fracture, the use of DXA to assess bone density early in life so that targeted bone-accrual programs can remedy any BMD deficits is undeveloped. IASTM study a passive straight leg raise (PSLR) was used, while in the PNF study an active straight leg raise (ASLR) was used. Subjects performed a self-static stretch on 1 randomly selected leg and the alternative intervention was performed on the contralateral leg. Post-intervention measurements utilizing the respective straight leg raises were performed. The 2 datasets were analyzed separately for reliability indices and significant differences between interventions.

RESULTS: ICC and SEM indicated good reliability for both studies, and MDC values were small and similar. Both studies showed significant interactions between time and intervention (P < .05 for PNF and P < .001 for IASTM). Follow-up analyses revealed that the PNF and IASTM interventions resulted in more improvement than static stretching interventions.

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CLINICAL RELEVANCE: Hamstring tightness results in decreased functional efficiency during mobility and increased risk for injury in various clinical populations. Through statistical analysis of 2 emerging alternative interventions, this study provides evidence of their comparative merit as treatment choices and informs clinicians seeking to address the impairment of clinically-shortened hamstrings.

OP0121

FUNCTIONAL MOVEMENT-BASED TRAINING TO REDUCE INJURY RISK IN FIREFIGHTERS

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PURPOSE/HYPOTHESIS: The purpose of this study was to determine the effectiveness of functional movement based training in reducing injury risk and improving FMS scores in fireman staff. We investigate the working hypothesis that regular training based on functional movement principles will improve individuals' FMS scores and reduce risk of injury for high and moderate risk subjects.

NUMBER OF SUBJECTS: Seventy-five.

MATERIALS/METHODS: Data were collected from 75 male subjects (mean ± SD age, 43 ± 7 years). Two physical therapists and a certified personnel trainer, certified in FMS screening, implemented screening. In addition to the FMS, a lifting and recovery assessment involving a pass/fail 20-10-20 second hurdle jump, and a 55-lb lift from the floor with trunk rotation was collected. Subjects were separated into 3 categories; High risk (FMS 0-10/Fail), Moderate Risk (FMS 11-14/Pass), and Low Risk (FMS 15-21/Pass). Customized programs were assigned to subjects based on their risk group for a minimum of 3 d/wk for a 12-week period. Subjects had an optional trainer guided exercise 1 d/wk through the duration of the study. FMS scores were collected at intake, 12 weeks, 24 weeks, and 36 weeks. Movement based programs were progressed every 12 weeks based on individual FMS score improvements and changing dysfunctional patterns.

RESULTS: There was a significant difference among the entire work force between the 12-week, 24-week, and 36-week FMS score from intake scores (P < .05). There was not a significant change in score in the low risk group between all time intervals and intake scores (P > .05). There was
a significant change in both lifting and recovery assessment scores between the 24 week and 36 week from intake scores for all groups (P < .05). Additionally there was a significant difference in injury rate per hour work among the entire staff from the year 2015 to 2016 (P < .05).

CONCLUSIONS: By assessing the subjects for general dysfunction using the Functional Movement Screen and producing a functional fitness program emphasizing the inhibited areas of the body, overall injury rate can be reduced resulting in less workers compensation claims and higher subject performance.

CLINICAL RELEVANCE: Clinicians can develop confidence in utilization of FMS system including open access to a physical therapy treatment to improve movement efficiency and reduce injury risk. By reducing the rate of injury in high risk occupations such as firefighting, companies can experience improved performance from employee base as well as reduced cost associated with workers comp claims. These principles can be applied to other tactical work forces as well as general fitness training principles.

OP0123

TREATMENT FIDELITY AMONG TREATMENT PROVIDERS IN A MULTICENTER, RANDOMIZED CLINICAL TRIAL COMPARING 2 REHABILITATION STRATEGIES FOR PEOPLE WITH PÆRHARTITIC HIP DISEASE

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PURPOSE/HYPOTHESIS: Treatment fidelity is important to ensure internal validity and external validity of a randomized clinical trial (RCT). We have implemented a feasibility, multicenter RCT to compare movement pattern training (MPT) to standard rehabilitation for people with prearthritic hip disease (PAHD). Our purpose was to establish treatment fidelity among participating treatment providers. We hypothesized that after training, providers will demonstrate H1) greater than 95% on post-training exam and H2) greater than 80% protocol adherence.

NUMBER OF SUBJECTS: Not applicable.

MATERIALS/METHODS: Patients with PAHD enrolled at 2 rehabilitation research sites are randomized to either MPT or Standard. We used the NIH Behavioral Change Consortium framework to establish treatment fidelity among 5 providers. Study design: The MPT protocol was reported in a previous study. A literature review was completed to develop Standard protocol. Active ingredients believed to affect patient outcomes for each treatment arm were identified and operationally defined. The protocols were then reviewed by clinical experts at both sites to ensure that each protocol reflected the underlying theory of its respective approach. A manual of operations (MOP) was finalized. Provider Training: The providers, 5 physical therapists with 6 to 27 years of experience, participated in onsite training led by the first author. Training included review and discussion of the MOP, role plays of scenarios to demonstrate treatment concepts and discussion to identify barriers to treatment adherence. Total training time at each site was 16 hours. Treatment Delivery: After training, providers completed a written exam and participated in role-played scenarios to assess treatment session procedures. A checklist was used to define and quantify standard performance of the active ingredients for each treatment arm. The first author scored all scenarios. Four scenarios for each provider were averaged for a final score. If a final score was below 95%, more training and discussion occurred and additional scenarios were completed. Treatment Receipt and Treatment Skills Enactment: Previously published methods were used to assess treatment receipt and skills enactment. The providers were trained in standard procedures to assess patient understanding of their assigned treatment, ability to perform exercises independently and to assess knowledge and independent performance of patient-specific tasks identified as impaired by the patient.

RESULTS: All providers scored greater than 95% on written exam and scenarios. 2 providers participated in additional scenarios to achieve 95%.

CONCLUSIONS: We have established treatment fidelity to initiate a multicenter RCT for patients with PAHD and developed methods to monitor treatment fidelity throughout study implementation.

CLINICAL RELEVANCE: Investigation of rehabilitation for PAHD is needed. We have established methods to optimize treatment fidelity within our
LOW BACK PAIN IN THE POSTRADIATION PATIENT: A CASE STUDY ON PROCTITIS

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BACKGROUND AND PURPOSE: Research suggests that 3% of patients have a nonmechanical source of low back pain that warrants appropriate referral for proper medical management (Jarvik et al 2002). It is important to be mindful of this when developing a differential diagnosis, as proctitis that can present as low back pain. Proctitis is due to a burn in the colon most often seen following pelvic radiation. Chronic proctitis, which occurs greater than 3 months postradiation, is said to occur in 10% of patients (Roche et al 1996). If left untreated, proctitis can lead to excessive bleeding, hemorrhage and possible death. The purpose of this case study is to highlight the clinical reasoning and differential diagnosis process for low back pain.

CASE DESCRIPTION: A 73-year-old Caucasian woman was referred to physical therapy for lumbar radiculopathy. Past medical history is significant for Sjogren’s, endometrial cancer treated via hysterectomy and pelvic radiation therapy 1 year prior, and hypertension. Over the past 4 months symptoms were improving with mechanical based treatment. However, on 24th visit she presented to clinic with new onset low back/sacral pain that was unchanged with mechanical assessment. Right upper quadrant and right kidney were positive for pain on palpation. She reported increased urinary frequency, burning with urination and abdominal cramping.

OUTCOMES: The patient was referred to her urologist. With no definitive diagnosis given, she returned to physical therapy with new reports of blood clots with bowel movement. She was then referred to gastroenterologist and was scheduled for a colonoscopy. The colonoscopy was negative for cancerous lesions but demonstrated radiation burn within the colon. She was given the diagnosis of proctitis. The burn was cauterized via formaldehyde solution. The patient returned to physical therapy 1 week later with decreasing episodes of bleeding and resolution of low back/sacral pain.

DISCUSSION: This case emphasizes the importance of continued screening for red flags throughout the course of care, especially in those with a significant past medical history. With increasing cancer survivorship it is important for physical therapists to not only screen for secondary cancer but also for complications following cancer treatment, as they can have severe consequences if not assessed and treated appropriately.

### Purpose/Hypothesis:
Evidence suggests that trigger point dry needling (TrP-DN) is an effective treatment, but few studies have distinguished whether or not it is more effective than conventional treatment methods such as myofascial release (MFR) and ischemic compression, specifically for the cervical musculature. The purpose of this systematic review was to analyze TrP-DN compared to conventional myofascial trigger point (MTrP) release techniques for the relief of cervicogenic pain.

### Number of Subjects:
Not applicable.

### Materials/Methods:
A literature search was conducted between the dates of March 2016 to January 2017 to identify studies that examined the effectiveness of TrP-DN and/or MFR techniques and ischemic pressure in reducing cervicogenic pain. Databases searched included: PEDro, Ebsco, CINAHL Complete, and PubMed. Search terms used include: dry needling, myofascial pain, trigger points, myofascial release techniques, and ischemic pressure/compression. Each of these terms were searched individually and/or in conjunction with the following terms: myofascial, trigger points, neck, neck pain, upper trapezius. Studies were included if they reviewed the treatment of MTrPs in the cervical region or upper trapezius, or compared the effectiveness of TrP-DN or ischemic pressure/MFR to a control, or TrP-DN to ischemic pressure directly. Studies were excluded if they were duplicates, not available in English, written earlier than 2006, or used surgical interventions or steroid injections. All studies were assessed on the PEDro scale and level of evidence scale.

### Results:
After analysis, 15 articles were considered appropriate for review. PEDro scores ranged from 6/10 to 8/10. Level of evidence scores ranged from 1b to 2b. All of the studies investigated the effectiveness of these treatment methods at reducing neck pain as well as additional symptoms. Six articles compared TrP-DN to a control group. One article analyzed the effectiveness TrP-DN without a control group. Five articles compared ischemic pressure/MFR to a control group. The remaining 3 studies compared TrP-DN and ischemic pressure directly.

### Conclusions:
Both TrP-DN and ischemic pressure are effective treatment methods for MTrPs in the upper trapezius. TrP-DN may be more favorable due to its cost effectiveness. In addition, ischemic pressure may not be suitable in all clinical contexts due to increased treatment sessions required. Therefore, more research is needed in regards to the effects of TrP-DN compared to ischemic pressure for the treatment of MTrPs. In particular, use of large sample sizes and long-term follow-up studies are recommended.

### Clinical Relevance:
This knowledge may be useful when determining the best treatment approach for patients with MTrPs resulting in cervicogenic pain. There is an increased cost effectiveness and decreased duration of treatment associated with TrP-DN when compared to both controls and ischemic pressure. However, TrP-DN may not be accessible in all regions due to professional practice acts.

### Materials/Methods:
Subjects were randomly assigned to an initial tester, and then completed a 1-minute walk and 3 passive first MTP extensions for warm up. The blinded tester placed a caliper on the dorsum of the foot at 50% of foot length in the resting position, and then re-positioned the caliper at maximal passive first MTP extension. Measurements of each position were read by an assistant and were repeated 3 times. The procedure was repeated by a second tester. All subjects returned within 48 hours and repeated the same testing procedure.

### Results:
The mean of 3 measures for change in DAH were determined for each day for each tester. Mean change in DAH for Day 1/Day 2 was 3.552 mm/4.106 mm for tester 1, and 3.533 mm/3.383 mm for tester 2. Intratester reliability using ICCs was moderate (0.733) for tester 1 and strong (0.818) for tester 2. ICC values for intertester reliability were variable with moderate reliability on Day 1 (0.719), and poor to moderate reliability on Day 2 (0.519). The combined Day 1 and Day 2 ICC for intertester reliability exhibited poor to moderate reliability (0.625). Researchers observed subtle differences in testing environment from Day 1 to Day 2.

### Conclusions:
Using a measure of DAH during a modified Windlass test may be valuable for a single tester, as intertester reliability was strong. Use of this measure when completed by more than 1 examiner should be evaluated with caution as intertester reliability was poor to moderate. Our data suggest, however, that intertester reliability may vary on different days. Differences in testing environment may affect testing results on different days.

### Clinical Relevance:
The windlass mechanism should be considered in measuring midfoot mobility. Existing methods do not account for changes in soft tissue supporting structures which are related to movement. The effect of the windlass mechanism on DAH may provide clinicians the ability to assess midfoot mobility related to plantar fascial mobility during the heel off to toe off phase of the gait cycle. Measuring change in DAH during a modified Windlass test by a single tester may provide a reliable measure of the contribution of the plantar fascia to midfoot mobility.

### PERPLEXING POLYNEUROPATHY: HONING CLINICAL SKILLS FOR AUTONOMOUS PRACTICE

**Germaine Herman**

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### Background and Purpose:
Unrestricted direct access for physical therapy services continues unfolding across the nation. Physical therapists (PT) aiming for unhindered direct access are challenged to maintain thorough clinical competence for appropriate management and referral as needed. This case study highlights the evaluative skills needed for a highly irregular patient symptomatology that did not fit any known musculoskeletal diagnostic criteria.

### Case Description:
M.C. is a 59-year-old woman with a history of hypertension, anxiety and depression, referred to PT for low back pain. MC presented with a 5-week history of gradual, progressive numbness and weakness in all extremities and trunk, including saddle anesthesia. She denied bowel/bladder incontinence. She reported daily falls, an inability to walk without a walker, form a fist or grasp items. MC reported needing assistance with all ADLs including fine motor activities. Prior to onset of symptoms, MC was fully independent and employed as a patient relations liaison. She had visited the emergency department (ED) twice during this time but was sent away with pain medication. She denied pain at the time of PT examination. Objective findings included the following: MC presented ambulating with a walker with a wide base of support, bilateral foot drop and knee hyperextension and unable to fully grip the walker. She required assistance into standing and static balance was poor. Cervical and lumbar screens were clear. Neurologically, she demonstrated impaired light touch from C6 on below and the right and from C5 and below on the left. She scored a 2+ reflexes C5-C7 bilaterally and 1+ reflexes L4-L5 and S1-2 bilaterally. Myotomes were diffusely impaired beginning at C6 on the right and C7 on the left, with more distal myotomes scoring poorer than proximal. She was unable...
to oppose, grasp, dorsiflex or wiggle her toes bilaterally. Tone, cranial nerves, coordination and cognition were intact.

OUTCOMES: MC was immediately referred to the ED where an MRI of the spine proved unremarkable. Upon hospital admittance, an electromyography/nerve conduction study (EMG/NCS) showed subacute severe distal sensorimotor axonal polyneuropathy in the upper limbs. Differentials included vasculitis or an infectious cause of this polyneuropathy. All testing was negative except her bloodwork was positive for antineutrophil cytoplasmic antibodies (MPO-ANCA), immune system autoantibodies that are sensitive and specific blood markers of systemic vasculitis. In this condition, these autoantibodies erroneously attack proteins in white blood cells, specifically myeloperoxidase (MPO) and proteinase 3 (PR3). Rheumatology was consulted but did not find any other systemic characteristics of ANCA-related vasculitis. MC was discharged with instructions to follow-up with multiple providers for continued workup and was referred to neurological physical therapy.

DISCUSSION: The ability to thoroughly evaluate and refer appropriately is a skill that is needed for physical therapists to responsibly manage unhindered direct access.


OP0129

UTILIZATION OF MANUAL THERAPY TO THE LUMBAR SPINE FOR INDIVIDUALS WITH BILATERAL LOWER EXTREMITY CRPS: A CASE SERIES

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BACKGROUND AND PURPOSE: CRPS is a poorly understood, disabling condition that is difficult and challenging for physical therapists to treat. Conservative therapies for CRPS have traditionally focused on pain management in combination with strength and flexibility training and manual soft tissue techniques to the involved extremity. Manipulation and mobilization of the spine is used successfully to treat a variety of musculoskeletal conditions but the literature on its use for treating CRPS is sparse. The primary purpose of this case series is to demonstrate a relationship between distal lower extremity symptoms of CRPS and the lumbar spine while displaying the feasibility of utilizing manual therapy to the lumbar spine when treating patients with lower extremity CRPS.

CASE DESCRIPTION: Two patients were referred to physical therapy with the diagnosis of lower extremity CRPS. Both patients were treated with manual physical therapy to their lumbar spine with the use of soft tissue mobilization and lumbar mobilization/manipulation. Mobilization was utilized when patients were highly irritable with progression to thrust manipulation as irritability improved and patient tolerated the manipulation positioning. In addition, they received exercises to improve strength and lumbar active and passive mobility. Outcome measures included the modified Oswestry Disability index (ODI) as well as the Lower Extremity Functional Scale questionnaire (LEFS). Both measures were assessed at initial examination and discharge from physical therapy.

OUTCOMES: Both patients completed their entire plan of care as prescribed by the treating therapist. Patient 1 was a 52-year-old man and patient 2 was a 32-year-old woman with duration of symptoms prior to initial examination 14 and 12 months respectively. Patient 1 received 13 sessions over 6 weeks resulting in a 34-point improvement in ODI and 35-point improvement in LEFS. Patient 2 received 21 sessions over 12 weeks resulting in a 28-point improvement in ODI and a 41-point improvement in LEFS. Neither patient demonstrate subjective or objective adverse effects to mobilization or manipulation.

DISCUSSION: Both patients exhibited reductions in pain as well as a clinically meaningful improvement in function, based on their functional outcome studies. As a result of central mechanisms, there may be a link between the lumbar spine and distal symptoms in patients with CRPS-1. Manual therapies when applied to the lumbar spine in these patients resulted in improved spinal mobility, decreased pain and reduction is distal referred symptoms. Although one cannot infer a cause and effect relationship from a case series, the outcomes with these patients have demonstrated meaningful clinical outcomes associated with manual physical therapy to the lumbar spine for patients who suffer from bilateral lower extremity CRPS.

**COMBINED SECTIONS MEETING**

**OPO131**

**EFFECTIVENESS OF TRIGGER POINT DRY NEEDLING FOR LATERAL EPICONDYLITIS VERSUS LATERAL EPICONDYLITIS: A REPORT COMPARING 2 CASES**

**April Hodge**

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**BACKGROUND AND PURPOSE:** Trigger points have been shown to cause pain in both acute and chronic conditions. Dry needling is a technique that is utilized to reduce pain and improve function in muscles affected by trigger points. The purpose of this study was to investigate the effectiveness of trigger point (TrP) dry needling (DN) on the improvement of grip strength and pain in a patient with acute onset lateral epicondylitis and a patient with chronic lateral epicondylitis.

**CASE DESCRIPTION:** A 39-year-old male Army veteran, with acute onset of left lateral epicondylitis and a 29-year-old male active-duty Navy service member, with chronic right lateral epicondylitis were both receiving physical therapy services in a multidisciplinary outpatient day program for service members with mild to moderate brain injury and posttraumatic stress disorder. Both individuals presented with decreased grip strength and pain as a result of their diagnosis.

**OUTCOMES:** A hydraulic hand dynamometer was used to assess grip strength in neutral, supination, and pronation and the numeric pain-rating scale (NPRS) was used to assess the patient’s pain level. Both measures were completed pre and immediately post intervention, and at 1 and 4 weeks after discontinuing the treatment. TrP DN was used for 1 treatment session to the wrist extensor bundle in the case of acute onset of lateral epicondylitis. In this case, the patient’s pain free grip strength improved from 61 lb preintervention to 119 lb 1 month post treatment in neutral. The patient’s pain free grip strength improved from 85 lb preintervention to 120 lb 1 month post treatment in supination. The patient’s pain free grip strength improved from 22 lb preintervention to 103 lb 1 month post treatment in pronation. His NPRS improved from 5.3/10 preintervention to 0/10 1-month postintervention. In the case of chronic lateral epicondylitis TrP DN was used 1 time per week for 4 weeks to the wrist extensor bundle. In this case, the patient’s pain free grip strength improved from 56 lb preintervention to 110 lb 1 month post treatment in neutral. The patient’s pain free grip strength improved from 59 lb preintervention to 105 lb 1 month post treatment in supination. The patient’s pain free grip strength improved from 22 lb preintervention to 95 lb 1 month post treatment in pronation. His NPRS improved from 4.3/10 preintervention to 0.3/10 1-month postintervention.

**DISCUSSION:** Grip strength and pain both improved after TrP DN. The outcomes from these 2 cases suggest that grip strength and pain can improve with the use of trigger point dry needling in patients with lateral epicondylitis and epicondylitis. Future research using randomized control trials needs to be conducted in this area. TrP DN does appear to be a viable intervention to be used in physical therapy to improve grip strength and reduce pain.

**REFERENCES:**


**OPO132**

**FRONTAL PLANE MUSCLE STRENGTH AND RANGE OF MOTION OF THE HIP AND ANKLE IN FEMALES WITH PATELLOFEMORAL PAIN**

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**PURPOSE/HYPOTHESIS:** Patellofemoral pain (PFP) affects physically active young adults and adolescents and is more common in females than males. The etiology of PFP is multifactorial and studies have examined proximal and distal lower extremity regions as possible contributing factors. Greater hip adduction motion during gait and weakness of hip abductors are reported to be associated with PFP. Although not as extensively investigated as the hip, the ankle and foot have been examined in persons with PFP. Studies reported greater rearfoot eversion motion during gait in persons with PFP compared to healthy subjects. Factors related to frontal plane mechanics of the hip and rearfoot have been reported to be associated with PFP. No studies have examined frontal plane rearfoot and hip musculature and joint range of motion (ROM) in the same participants to explore their association with PFP. The purpose of this study was to examine frontal plane strength and ROM of the hip and ankle/rearfoot in females with PFP compared to females without PFP.

**NUMBER OF SUBJECTS:** Fifty-two.

**MATERIALS/METHODS:** Twenty-six females were recruited for each group.
Mean ± SD ages were PFP: 23.2 ± 2.8 years and control: 23.6 ± 2.2 years. Reported symptoms and function were examined with the Anterior Knee Pain Questionnaire (AKPS). Activity level was examined with the Tegner Activity Level scale. The most painful lower extremity was tested for PFP group participants and the right lower extremity was tested for the control group. Height, weight, subtalar neutral position, frontal plane hip and ankle ROM were all measured. Peak isometric torque of the hip adductors, hip abductors, ankle inverters, and ankle evertors were measured with an instrumented dynamometer. The average of 3 contractions was calculated and normalized by height and mass for group comparisons. Parametric and nonparametric statistics were used to analyze data as appropriate.

RESULTS: No differences were present between groups for age, mass, height, body mass index, or activity level. The PFP group had worse pain and function than the control group with a significantly lower AKPS score (median PFP, 80.5; control, 100; Mann-Whitney U test, P < .001). PFP group subtalar neutral joint position was less varus than the control group (mean PFP, 1.65°; control, 4.27°; t test P = .010). Although it did not reach significance, the PFP group rearfoot inversion ROM, rearfoot eversion ROM, ankle inverter torque, hip abductor torque, and hip adductor torque were less than in the control group.

CONCLUSIONS: Our findings suggest that a more neutral, that is, less varus, rearfoot position may be a factor associated with PFP in some young adult females. The total rearfoot inversion and eversion ROM were less in the PFP group, suggesting that the total available rearfoot motion may have been reduced.

CLINICAL RELEVANCE: A less varus subtalar neutral joint position and restricted rearfoot motion may be factors associated with PFP in some females. These persons may benefit from interventions to improve subtalar joint mobility.

OP0133

PATELLOFEMORAL JOINT LOADS VARY WITH RUNNING SPEED: APPLICATION TO INDIVIDUALS AFTER ACL RECONSTRUCTION

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PURPOSE/HYPOTHESIS: Patellofemoral pain (PFP) is a common running-related injury that is reported by 30% to 50% of individuals 1 to 7 years after anterior cruciate ligament reconstruction (ACL/R), regardless of graft type. Temporary reductions in running speeds are often prescribed for PFP, presumably to reduce patellofemoral joint (PFJ) loads. However, the relationship between running speed and PFJ force has not been previously described. The purpose of this study was to test the relationship between PFJ force and running speed among individuals with a history of ACL/R.

NUMBER OF SUBJECTS: Twenty recreationally active individuals with a unilateral ACL/R (15 female; mean ± SD age, 21.8 ± 3.6 years; 47 ± 18 months postsurgery).

MATERIALS/METHODS: 3-D lower extremity kinematics (200 Hz) and ground reaction forces (1000 Hz) were collected during running on an instrumented treadmill at 80%, 90%, 100%, 110%, and 120% of each participant's preferred running velocity (2.73 m/s). Estimated quadriceps, hamstring, and gastrocnemius muscle forces during 5 stance phases of the ACL/R limb were derived from these data and input to a PFJ biomechanical model. Average peak PFJ contact force, PFJ force impulse, and PFJ force impulse/kilometer were evaluated using separate repeated measures analyses of variance and polynomial contrasts for tests of linear trends across speed conditions (α = .05). Average percent change and effect size (d) relative to preferred (100%) running speed were calculated to illustrate the magnitude of the speed effects on these PFJ force variables.

RESULTS: On average, for every 10% increase in running speed, peak PFJ force increased 0.2 BW (7%, d = 0.17, P < .001) and PFJ impulse/kilometer decreased 21 BW·s (–14%, d = –0.46, P < .001). No relationship was identified between PFJ force impulse/step and running speed (P = .58). Based on the results, we estimate that for a 150-lb athlete, a 20% running speed reduction would decrease peak PFJ force by 0.4 BW/step (60 lb) but increase cumulative PFJ impulse by 264 BW·s (31 500 lb) over a 5-km run.

CONCLUSIONS: Reducing running speed resulted in small peak PFJ force reductions but, owing to a shorter step length, longer stance time, and greater number of steps per kilometer, substantially increased overall PFJ impulse/kilometer. Conversely, increasing speed mildly increased peak PFJ force but significantly reduced overall PFJ impulse/kilometer.

CLINICAL RELEVANCE: Athletes with a history of ACL/R are at increased risk for PFP and cumulative PFJ loads have been implicated in the etiology of this running-related injury. Decreasing running speed increases cumulative PFJ force/kilometer and may be counterproductive to effective rehabilitation strategies for PFP. Instead, the relatively large reductions in total PFJ force/kilometer at higher running speeds may be desirable and feasible in the context of interval training exercise protocols.

OP0134

THE ROLE OF PHYSICAL THERAPY AFTER FEMORAL ACETABULAR IMPINGEMENT HIP ARTHROSCOPY: DOES VISIT UTILIZATION AFFECT 1-YEAR CLINICAL OUTCOME SCORES?

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PURPOSE/HYPOTHESIS: Femoral acetabular impingement (FAI) surgery shows favorable results to return patients to daily activities and sports with less pain. Role of rehab after surgery has been shown helpful but little attention has examined utilization of physical therapy (PT). With less authorized PT visits and lower reimbursements, more attention should focus on identifying appropriate PT utilization to achieve adequate patient outcome scores. Purpose of the study was to examine effect of PT utilization, length of therapy episode and attendance of therapy to a formal PT discharge on 1 year patient reported outcome scores in FAI patients. We hypothesized these variable would be significantly related to 1 year outcome scores.

NUMBER OF SUBJECTS: One hundred eighty-two subjects (67 male, 115 female) between the ages of 15 and 55 years (mean ± SD age, 33 ± 10 years) who underwent surgery from January 2011 to March 2015 at Intermountain Health care by 1 surgeon.

MATERIALS/METHODS: Retrospective cohort study. Rehab was performed under guidance of 1 therapy team using a standard postop protocol. Linear regression modeling was employed with primary outcome of interest being 1-year outcome scores on the International Hip Outcome Tool-12 (iHOT 12). Predictor variables included attendance of PT visits, length of therapy episode and discharge status (formal versus self), while controlling for age, sex, preoperative iHOT score and Tegner activity score (presurgery). Exclusion criteria included revision FAI, bilateral FAI surgery or attendance of PT less than 4 weeks. This study was approved by the Intermountain Central Region Institutional Review Board.

RESULTS: No significant effect was found for PT utilization or attendance of PT to formal discharge. Length of therapy episode was significantly related to 1 year iHOT scores (P = .04). A significant effect was found for iHOT score at final PT visit attended (P = .00) and for sex (P = .03). Patients attended a mean of 7.6 ± 3.1 PT visits, mean episode of care 13.8 ± 6.9 weeks, and 60% attended therapy until formal discharge.

CONCLUSIONS: PT visit utilization and attendance of PT to formal discharge had no effect on 1 year patient reported scores. Scores were significantly related to length of therapy episode indicating .5 point less on 1-year iHOT for every additional week in therapy. It’s possible some patients may achieve similar long-term outcome scores with shorter attendance of PT however, clinically this score change may not be relevant.
It appears that the outcome score collected at the final PT visit is significantly related to 1 year scores. Females demonstrated 7-point higher score on the IHOT compared to males. No other variables were significant. Although our hypothesis was not confirmed there may be subgroups not captured in our study that may require varied utilization models and future studies should address this.

CLINICAL RELEVANCE: We should continue to examine utilization of formal PT within the postop FAI population to help achieve favorable outcomes with appropriate visits.

**OP0135**

**MANUAL THERAPY INTERVENTIONS IN A COMPLEX CASE OF UPPER-QUARTER SYMPTOMS IN A PROFESSIONAL VIOLINIST**

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**BACKGROUND AND PURPOSE:** To illustrate how knowledge of clinical anatomy, biomechanics, and orthopaedic manual therapy can be applied to the examination and treatment of a violinist.

**CASE DESCRIPTION:** A 48-year-old professional violinist presented with multiple symptoms. These symptoms included: headache, temporomandibular pain, pain at the base of her neck, interscapular soreness, lateral arm pain, and paresthesia of the left fifth digit. She had prior treatment for these symptoms but received no relief. Prior treatment included: chiropractic, massage therapy, acupuncture, Roling, and craniosacral therapy. The following findings were found upon physical examination: forward head, stiff lower cervical spine segments, soreness with left temporomandibular joint play testing, stiffness of the left first rib, weakness in bilateral scapular stabilizers, a positive Spurling A test on the left, and a positive left ulnar nerve neurodynamic test. Treatment for the above symptoms consisted of 1 visit per week for 4 weeks. The treatment included: posture correction, joint mobilization of the cervical spine, suboccipital release, temporomandibular joint mobilization, ergonomics suggestions for the chin rest, left first rib mobilization, thoracic thrust manipulation, strengthening for the scalpel stabilizers, cervical spine right lateral flexion mobilization, and left ulnar nerve nerve slider exercises.

**OUTCOMES:** Following 4 sessions of physical therapy and a home exercise program over a 1 month period the patient had full resolution of all symptoms. She was able to play violin and perform all other activities symptom-free.

**DISCUSSION:** Manual orthopaedic physical therapy and a home program were effective in resolving all symptoms in a complex case involving the upper quarter in a professional violinist. Knowledge of clinical anatomy, biomechanics, and manual therapy can be very helpful in treating violinists. Violinists can develop a multitude of musculoskeletal symptoms due to their long hours of practice.


**OP0136**

**CREeping PHenomenon OBServed DuriNg AnterOPOSTerior GliDE MoBilizAtion oF The GlENoHUmeral jOint In PatiEnts wITh Adhesive CaPsulitis**

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**PURPOSE/HYPOTHESIS:** The purpose of this study was to investigate the creeping phenomenon of the glenohumeral joint (GHJ) during AP glide mobilization (APG) in neutral and rotated positions in patients with adhesive capsulitis and their age matched controls.

**NUMBER OF SUBJECTS:** Thirteen patients diagnosed with adhesive capsulitis (FG mean ± SD age, 58.46 ± 5.36 years) and 16 age-matched controls (CG age, 55.38 ± 5.71 years) participated.

**MATERIALS/METHODS:** A robotic manipulator with a 6-component load cell was used to perform APG on right GHJ in a direction perpendicular to the plane of scapula. The participant was tested lying supine on a firm treatment table. Five repetitions of APG were performed randomly in the following 3 positions of arm rotation: 60° of external (ER), neutral (NP), and 60° of internal rotation (IR). The peak force applied was 7 kg and maintained for 5 seconds. The magnitudes of displacement at 7 kg (Dspl_7 kg) and during holding phase (Dspl_hold) were calculated from each of the 5 repetitions. Two-way (group/position) and 3-way (group/position/repetition) mixed-model ANOVAs with repeated measures were used to assess main effects on Dspl_7 kg and Dspl_hold, respectively.

**RESULTS:** There were group (F = 5.851, P = .023) and position (F = 17.847, P < .001) main effects on Dspl_7 kg and group and position interaction (F = 4.590, P = .016). Group differences were found at external rotation (CG, 18.844 mm; FG, 13.02 mm; P = .001). Position differences were found in both CG (IR>ER: t = –2.949, P = .010) and FG (NP>ER: t = –4.575, P = .001; IR>ER: t = –6.405, P < .001). There were main effects of group (F = 184.213, P < .001) and repetition (F = 37.090, P < .001) on Dspl_hold without 2-way or 3-way interaction. Group differences was noted at ER (CG, 0.66 ± 0.17 mm; FG, 0.53 ± 0.16 mm; P = .034). Position difference was found only in FG (IR>ER: t = –2.175, P = .05). Group differences were found at ER position at third (CG, 0.7151 ± 0.3296 mm; FG, 0.5041 ± 0.1624 mm; P = .042), fourth (CG, 0.5464 ± 0.1170 mm; FG, 0.4349 ± 0.0807 mm; P = .007) and fifth (CG, 0.6327 ± 0.3204 mm; FG, 0.3448 ± 0.1297 mm; P = .005) repetitions.

**CONCLUSIONS:** AP displacement (DSPL_7 kg) assessed during APG is smaller for FG in ER position than that of normal controls. During the 5sec holding phase, FG exhibit a smaller additional increase in AP displacement due to creeping than that of CG in ER position. Our results render support to the concept that capsuloligamentous structures restraining ER are predominantly involved in patients with adhesive capsulitis.

**CLINICAL RELEVANCE:** Robotic manipulator has potential for clinical evaluation when measurement precision and reliability of displacement/force parameters are of concern. Present study presented such a system for assessing, in vivo, APG mobilization of the GHJ of patients with adhesive capsulitis. Our results render support to the concept that capsuloligamentous structures restraining ER are predominantly involved in patients with adhesive capsulitis.

**OP0137**

**CLINICAL DECISION MAKING WITH AN UNDIAGNOSED POSTTRAUMATIC FRACTURE OF PUBIC BONE**

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**BACKGROUND AND PURPOSE:** Post-traumatic fracture of the pubic bone should be considered as acute injuries post falling with an aging and labor-intensive workforce. A physical therapist’s (PT) knowledge of abnormal patient presentation is essential to the clinical decision-making process of traumatic musculoskeletal-related injuries.

**CASE DESCRIPTION:** A 46-year-old female food service worker experienced sharp pain in the right buttock and posterolateral hip and thigh after tripping over a piece of metal and falling onto concrete. Initial X-rays were
Participants completed the Fear of Pain Questionnaire (FPQ). Retroreflective markers were placed on the participants’ skin superficial to C7 and S1. Trunk to height ratio (THR), an anthropometric variable, was calculated as the vertical distance from C7 to S1 divided by total participant height. Participants then stood for 2 hours performing light work tasks at a standing desk. Every 15 minutes, participants rated their LBP intensity on a visual analog scale. A 2-level hierarchical linear model was used to examine the effects of time, anthropometry (THR) and FPQ Minor subscale scores on the course of LBP in PDs.

RESULTS: Thirty-three participants were PDs (16 male; mean ± SD age, 25.0 ± 3.1 years; BMI, 22.8 ± 3.2 kg/m²). An unconditional hierarchical linear model determined the within-individual (Level 1) and between-individual variance (Level 2), which were 72% and 28%, respectively. Linear time was a significant predictor, explaining 80% of the variance within-individuals. THR and FPQ minor subscore were significant Level 2 between-individual predictors. The coefficients for THR and the FPQ Minor subscore were significant for both the intercepts (pi0 = 0.45, pi0 = 0.27) and slopes (pi1 = 0.77, pi1 = 0.48) (P<.01). The final regression equations were: Level 1: LBP(t) = B0 + B1 Time + B2 FPQminori + B3 THRi + u0i; B1i = pi10 + pi11 FPQminori + pi12 THRi + u1i.

CONCLUSIONS: Linear time spent standing explained 80% of the within-individual variance in LBP. As time increased, the LBP intensity reported also increased. Higher fear scores were associated with greater LBP at any given time point, as well as a faster increase in LBP intensities over time. Likewise, the greater the THR, the greater the LBP and the faster the increase in LBP over time.

CLINICAL RELEVANCE: Most of the variability existed within individuals, suggesting that time spent standing is the best predictor of LBP intensity over time. Thus, decreasing total time spent standing would be most important to target to reduce LBP intensity during standing. Fear of pain also may be a modifiable factor to address to reduce LBP intensity in standing. Longer trunks were associated with greater LBP; however, this factor cannot be modified.

OP0138
THE EFFECTS OF ANTHROPOMETRY AND FEAR OF PAIN ON THE COURSE OF LOW BACK PAIN DURING PROLONGED STANDING
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PURPOSE/HYPOTHESIS: The prevalence of low back pain (LBP) is higher in people whose occupations require prolonged standing. Knowledge of the risk factors for LBP, however, is particularly lacking for low load, static activities. Prior studies have shown that during a laboratory-based, standing paradigm, 40% to 50% of back-healthy people develop acute, transient LBP (pain developers; PD). Our purpose was to study, in PDs, the effects of 2 potential risk factors, anthropometry and fear of pain, on the course of LBP over 2 hours of standing.

NUMBER OF SUBJECTS: Seventy-one healthy participants without a history of LBP, chronic pain, medical conditions, anxiety, or depression. All participants stood fewer than 4 hours total per day and stood confined less of LBP, chronic pain, medical conditions, anxiety, or depression. All participants rated their LBP intensity on a visual analog scale. A 2-level hierarchical linear model was used to examine the effects of time, anthropometry (THR) and FPQ Minor subscale scores on the course of LBP in PDs.

RESULTS: Thirty-three participants were PDs (16 male; mean ± SD age, 25.0 ± 3.1 years; BMI, 22.8 ± 3.2 kg/m²). An unconditional hierarchical linear model determined the within-individual (Level 1) and between-individual variance (Level 2), which were 72% and 28%, respectively. Linear time was a significant predictor, explaining 80% of the variance within-individuals. THR and FPQ minor subscore were significant Level 2 between-individual predictors. The coefficients for THR and the FPQ Minor subscore were significant for both the intercepts (pi0 = 0.45, pi0 = 0.27) and slopes (pi1 = 0.77, pi1 = 0.48) (P<.01). The final regression equations were: Level 1: LBP(t) = B0 + B1 Time + B2 FPQminori + B3 THRi + u0i; B1i = pi10 + pi11 FPQminori + pi12 THRi + u1i.

CONCLUSIONS: Linear time spent standing explained 80% of the within-individual variance in LBP. As time increased, the LBP intensity reported also increased. Higher fear scores were associated with greater LBP at any given time point, as well as a faster increase in LBP intensities over time. Likewise, the greater the THR, the greater the LBP and the faster the increase in LBP over time.

CLINICAL RELEVANCE: Most of the variability existed within individuals, suggesting that time spent standing is the best predictor of LBP intensity over time. Thus, decreasing total time spent standing would be most important to target to reduce LBP intensity during standing. Fear of pain also may be a modifiable factor to address to reduce LBP intensity in standing. Longer trunks were associated with greater LBP; however, this factor cannot be modified.

OP0139
RAPIDLY INCREASING INCIDENCE IN SCOLIOSIS SURGERY OVER 14 YEARS IN A NATIONWIDE SAMPLE
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PURPOSE/HYPOTHESIS: Severe scoliosis is primarily managed with surgery. This study describes the incidence of surgically treated scoliosis among Swedish children and adolescents, stratified by age and sex, scoliosis type, and surgical approach. The study also identifies changes in incidence rate and hospital length of stay (LOS), infections requiring revision surgery and mortality within 90 days.

NUMBER OF SUBJECTS: Three thousand sixty-two Swedish youth aged 0 to 21 years.

MATERIALS/METHODS: Swedish youth with diagnostic codes for scoliosis and spine surgery between 2000 and 2013 were selected from the Swedish National Patient Register. Incidence was computed by comparing children with surgically treated scoliosis to the total number of children at risk in the population. Linear regression models and spearman correlation coefficients analyzed trends in surgical factors and outcomes over time. Relative risks were used to calculate risk of revision surgery.

RESULTS: Overall annual incidence per 100 000 children was 9.1 (5.9 for boys and 12.5 for girls). Annual incidence increased over 14 years from 5.1 to 9.8; for an average of 4.6% per year (P<.0001). Surgery for adolescent idiopathic scoliosis was most common (4.5 per 100 000 children (n = 1516), followed by neuromuscular 2.7 (n = 913) and congenital scoliosis 0.7 (n = 236). Average LOS decreased among all types of scolio...
FUNCTIONAL VERSUS STANDARDIZED: WHICH GLUTEUS MEDII STRENGTH TEST BEST CORRELATES TO RISK OF KNEE INJURY IN COLLEGIATE SOCCER PLAYERS? Lindsay M. Jaksza, Gary Schneider, Corey Hughes, Angela J. Rich, Mary E. Parker

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PURPOSE/HYPOTHESIS: Hip muscle weakness, specifically of the gluteus medius (GMed), has been correlated to knee injuries, including patellofemoral pain syndrome, anterior knee pain, and anterior cruciate ligament (ACL) tears. Given the high prevalence of knee injury incurred while running, focusing on appropriate GMed activation, strength, and function is imperative for optimal biomechanics and prevention of injury. Electromyography (EMG) research has shown that GMed is at peak activation during the loading response of the running cycle, a position of hip flexion. This study proposes that strength testing of the GMed in a position of hip flexion, abduction, and external rotation, compared to the standardized position of abduction and extension, provides an improved reflection of functional movement. This study hypothesizes that a functional GMed strength test is more strongly correlated to risk of knee injury in collegiate soccer players than the standardized hip abduction manual muscle test.

NUMBER OF SUBJECTS: Participants were 85 collegiate soccer players.

MATERIALS/METHODS: Manual strength testing for GMed was performed in both the standardized hip abduction position and a functional GMed strength test position bilaterally on 85 collegiate soccer players. Players completed a survey to assess prior knee injuries, and will receive a second survey in December 2017 to assess for any knee injury acquired during the standardized hip abduction position. The increase in surgical treatment for scoliosis (including children formerly considered at high risk) with concurrent decreases in hospital LOS, may impact post-operative rehabilitation and influence outpatient and home therapy referrals for these children. The shift to posterior fusions has implications for postoperative rehabilitation programs. The increase in surgery among adolescents with idiopathic scoliosis is associated with high 90-day postoperative infections and mortality rates.

CONCLUSIONS: Surgical management of scoliosis is increasing with a concurrent decrease in hospital LOS in Sweden. Similar trends have been found in large US studies. The rise in scoliosis surgery was driven primarily by increases in surgical management for adolescent scoliosis. Surgical management of neuromuscular scoliosis is associated with high 90-day postoperative infections and mortality rates.

CLINICAL RELEVANCE: Increases in surgical treatment for scoliosis (including children formerly considered at high risk) with concurrent decreases in hospital LOS, may impact post-operative rehabilitation and influence outpatient and home therapy referrals for these children.

OUTCOMES: The patient reported an immediate relief in lateral hip and anterior groin pain following manipulation to the TLJ during each treatment session. At discharge, patient subjectively reported feeling “100% better,” his pain decreased to 0/10, he demonstrated normal, pain free movement patterns in people with and people without low back pain who were studied in a randomized controlled trial. This syndrome can easily mimic other radicular symptoms and the TLJ is frequently overlooked during lumbar evaluations due to the low prevalence of discogenic pathology, particularly in younger populations. The purpose of this case report is to outline the patient/client management of TLJ syndrome in a collegiate baseball player with a comorbid acute lumbar disc herniation using an evidence-based manual therapy, and sport-specific therapeutic exercise approach.

CASE DESCRIPTION: A 19-year-old male collegiate baseball player was referred to physical therapy for an acute lumbar disc herniation. The patient presented with left-sided low back pain which radiated to his left hip, anterolateral thigh proximal to the knee, and anterior groin. His anterolateral thigh pain centralized and low back pain was diminished with repeated extensions in prone, however the pains in his left lateral hip and anterior groin were not affected and instead were reproduced with transverse shearing of the TLJ spinous processes. He also demonstrated a positive skin rolling test, and point tenderness along the posterior iliac crest approximately 7 cm from midline, which is consistent with TLJ syndrome. On initial evaluation, he rated his pain as 8/10 on the numeric pain rating scale, and scored 13/50 on the Modified Oswestry Disability Index (ODI). Interventions included a thrust manipulation to the thoracolumbar junction and self-mobilizations were performed with sport-specific core strengthening exercises over 6 weeks of physical therapy treatment.

DISCUSSION: Thoracolumbar junction syndrome has been reported as a common source of low back pain, but their remains limited evidence in the physical therapy literature detailing accurate diagnosis or optimal treatment, particularly with comorbid lumbar disc herniations. Additionally, sport-specific motions during baseball include asymmetrical, high-magnitude, and high-speed rotational stress to the thoracolumbar spine during batting and throwing which could predispose these athletes to dysfunction. Therefore, TLJ syndrome should be considered as a differential diagnosis for low back pain with radicular symptoms in baseball players. Additionally, this case study appears to provide additional evidence to support the conservative management for TLJ syndrome.

EXERCISE THERAPY IN THE CONSERVATIVE TREATMENT OF FULL-THICKNESS ROTATOR CUFF TEARS: A SYSTEMATIC REVIEW

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PURPOSE/HYPOTHESIS: With the prevalence of rotator cuff tears (RCT) reported in 54% of individuals older than 60 years of age, 80% in those older than 80 years of age, research has elucidated the role of conservative management for treatment of RCT. Although commonly prescribed, the evidence to support this approach is equivocal. The aim of this study is: (1) to conduct a systematic review of the literature to determine the current level of evidence available, (2) provide a formal GRADE of recommendation, and (3) provide support for an evidence-based exercise therapy (ET) protocol for full thickness rotator cuff tears (FTT).

NUMBER OF SUBJECTS: Two thousand ten shoulders in 35 studies.

MATERIALS/METHODS: MEDLINE, CINAHL, Embase, Cochrane, PEDro, Web of Science databases were searched to evaluate the effectiveness of ET for FTT. Inclusion criteria: randomized clinical trials or observational studies, adults with clinical diagnosis of FTT, or massive, or inoperable (RCT), a treatment group received ET for FTT, English language, and one of the following outcomes: pain, motion, strength, function, or quality of life (QoL). Exclusion criteria included: history of surgical repair, concurrent significant trauma or derangement to the shoulder, neurological impairment affecting the shoulder function, inability to access full text, and commentaries, editorials, or grey literature. Articles were assessed for quality, level of evidence (I-V) and grades of recommendation, utilizing Grading of Recommenda-tions Assessment Development and Evaluation (GRADE) ranging from A to F, expert opinion. Data extraction included: demographics, specific interventions and outcomes.

RESULTS: A total of 1569 unique citations were identified, 32 studies were included: 9 randomized control studies, 6 cohort studies, 15 case series and 5 case reports. There were 2010 shoulders in 1913 subjects with an average of 64.2 years of age, 54% male, 73% of tears were greater than 1 cm and 37% were classified as massive. Based on studies that reported, greater than 58% of tears were greater than 1 year and 73% were atraumatic. Of the nonoperatively treated cohorts that reported the respective outcomes: 78% improved in pain (9/10 cohorts that reported statistical significance [stat-sig] met P<0.05), 81% improved in ROM (14/14 cohorts that reported, met stat-sig), 85% improved in strength (7/8 cohorts that reported, met stat-sig), 84% improved in functional outcomes (17/17 cohorts that reported, met stat-sig). Dissatisfied outcomes occurred in 15% shoulders transitioned to surgery.

CONCLUSIONS: The current literature provided few high quality randomized control trials and predominantly observational studies, indicating GRADE B recommendation (moderate strength) to support the use of ET in the management of FTT. There is a need for well-designed randomized controlled trials investigating the efficacy of ET in the treatment of FTT.

CLINICAL RELEVANCE: With only 5% of those older than 60 years of age in the US with RCTs being treated with surgery and surgical retear rates of 25% to 90%, alternative treatment options are necessary. This review provides substantial evidence that ET is an effective treatment option for FTT.

EMG ANALYSIS OF LATISSIMUS DORSI, MIDDLE TRAPEZIUS, AND ERECTOR SPINAE MUSCLE ACTIVITY DURING SPINAL ROTATION

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PURPOSE/HYPOTHESIS: One of the most frequent movements occurring during activities of daily living and sports performance is rotation of the spine, a contributing factor in as many as 60% of back injuries. The latis-
Simus dorsi (LD) attaches to the spine, humerus, scapula, ribs, and pelvis and is one of the largest muscles of the back. Due to its size and multiple attachments, LD has the capability of influencing spinal movement during many different activities, however, most research concerning the LD has focused on its action on the upper extremity. Currently, the research on LD activation during spinal rotation is limited, as well as how findings may impact a patient’s plan of care. There is also limited research concerning the influence of the middle trapezius (MT) on spinal rotation even though this muscle has a broad attachment on spinous processes. The role of the erector spinae muscles during spinal rotation is well documented in the literature. The purpose of this study was to determine the LD and MT muscle activity throughout spinal rotation during open and closed kinetic chain activities utilizing ES as a reference.

**NUMBER OF SUBJECTS:** Thirty-eight healthy subjects (24 female) volunteered to be part of this IRB approved study.

**MATERIALS/METHODS:** Muscle activity of the LD, middle trapezius (MT) and erector spinae (ES) was recorded by surface electrodes while the subjects performed rotation to the left and to the right in standing (nonfixed) and quadruped positions (fixed). Spinal rotation motion was initiated in the 4 test positions (standing rotation right/left, quadruped rotation right/left) by movement of the pelvis. Muscle activity was normalized to the maximal voluntary contraction (MVC) of the muscle. Significance was set at α = .05 level.

**RESULTS:** The following muscles demonstrated significantly more EMG activity during spinal rotation with P < .05. In the quadruped position, with rotation of the spine right or left, as initiated at the pelvis, the contralateral LD and MT demonstrated more EMG activity than ES, and LD was more active than the MT. In the nonfixed position, LD did not demonstrate a significant impact on spinal rotation; however, MT was significantly more active than ES.

**CONCLUSIONS:** The LD and MT were found to be more active during fixed movements when the spine moved in a contralateral direction. With the nonfixed position, muscles such as ES and MT were found to have a greater role in rotation of the spine than LD. Results from this study can help to inform therapists to include the rehabilitation of LD and MT when spinal rotation is a component of the intervention for the client.

**CLINICAL RELEVANCE:** This study began to assess the rotational movement strategy of the LD in individuals without low back pain (LBP). Further studies will reveal if patients with LBP have similar movement strategies. In daily activities, many movements require spinal rotation with the upper extremities fixed as well as in quadruped position. Latissimus dorsi and MT should be considered when looking at spinal rotational movements with clients.

**OP0146**

**BIOMECHANICAL FACTORS RELATED TO KNEE PAIN IN CYCLISTS:**

**A SYSTEMATIC REVIEW OF THE LITERATURE**

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**PURPOSE/HYPOTHESIS:** Due to potential for knee injury, this systematic review sought to determine relationships between extrinsic factors and risks for knee injury in cyclists. Biomechanical studies examining kinematics, kinetics, and/or muscle activity under various cycling conditions and cycle settings were included. The specific question was “What biomechanical factors are related to knee injury risk for cyclists?”

**NUMBER OF SUBJECTS:** Not applicable.

**MATERIALS/METHODS:** Literature searches were performed using CINAHL, Ovid, PubMed, Scopus and SPORTDiscus. Publication dates were limited to the prior 12 years. Search terms included knee injuries, knee pain, cycling, cyclist, biomechanics, and overuse. Studies were required to include measurement of at least one the following at the knee during cycling: kinematics, kinetics, and muscle activity. Studies were excluded if not published in English, focused on injury at other sites, or evaluated traumatic injury. Quality of studies was assessed using the Downs and Black Scale for nonrandomized trials.

**RESULTS:** Searches resulted in 57 articles after duplicate removal. After title/abstract review, 29 articles remained for full text screening. From these articles, 14 met inclusion/exclusion criteria. Studies included were comparison or cross sectional. Only 4 studies included cyclists with knee pain. Studies were small with sample sizes of 9 to 24 participants, with

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**OP0145**

**PERFORMANCE OF BILATERAL AND UNILATERAL HEEL-RISE TASK IN PEOPLE WITH DIABETES MELLITUS AND PERIPHERAL NEUROPATHY**

Hyo-Jung Jeong, Michael J. Mueller, Mary Hastings

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**PURPOSE/HYPOTHESIS:** People with diabetes mellitus and peripheral neuropathy (DMPN) are at risk of developing foot deformity, a known precursor to skin breakdown and amputation.12 Intrinsic foot muscle atrophy is a predictor of foot deformity in those with DMPN.4,4 Intrinsic foot muscle function can be assessed by examining ankle and forefoot plantar flexion (PF) excursion during a unilateral heel rise task (UH).2 However, UH is a demanding task and may not accurately reflect the full available excursion of the ankle and mid-foot. The purpose of this study was (1) to compare differences between ankle and forefoot excursion and ankle power in the UH and bilateral heel rise tasks (BH); (2) to determine the relationships between UH and BH in ankle and forefoot excursion; and (3) to determine the relationships between ankle and forefoot excursion and self-reported physical performance.
239 participants across studies. Studies were of low to moderate quality with median Downs and Black score of 10. Biomechanical factors that may impact knee pain included cadence, power output, crank length, saddle fore/aft position, saddle height, and foot position.

CONCLUSIONS: Different cycling parameters (cadence and power output) and different bicycle settings have differing effects on cycling biomechanics at the knee. Some factors may increase or decrease risk for injury, and these factors may have differing effects based on the anatomical location or cause of the pain. While studies show differences across some extrinsic factors, there is a lack of direct relationship between parameters/positioning on the cycle and knee injury due to the limited studies examining cyclists with and without pain/injury. The results of this review can provide guidance to professionals treating cyclists with knee pain, but more research is needed.

CLINICAL RELEVANCE: With the increase in recreational and competitive cycling, cyclists are prone to overuse injuries and these injuries are occurring more commonly. Overuse injuries result from repetitive loading on the musculoskeletal system. Both intrinsic and extrinsic factors contribute to injury. Intrinsic factors relate to the cyclist and include fitness level and anatomical alignment. Extrinsic factors include the equipment, riding technique, and training. The knee is the most susceptible to injury during cycling due to the repetitive nature of the activity while generating torque on the pedal. Knee pain is the most common overuse related injury reported by cyclists, and intrinsic and extrinsic factors can contribute to the development of knee pain.

OP0147

USE OF MANUAL THERAPY PREOPERATIVE TO LUNG TRANSPLANTATION IN A PATIENT WITH IDIOPATHIC PULMONARY FIBROSIS: A CASE REPORT
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BACKGROUND AND PURPOSE: The purpose of this case report is to describe the outcome of a patient with idiopathic pulmonary fibrosis treated with manual therapy as a primary intervention from a physical therapist (PT) in an outpatient orthopaedics setting. Idiopathic pulmonary fibrosis (IPF) is a life threatening lung disease, often requiring lung transplantation for prolonged quality of life and survival. Recommended guidelines for pulmonary rehabilitation have not reported the use of manual therapy, specifically addressing thoracic hypomobility and chest expansion, as well as the effects of manual physical therapy preoperative to a lung transplantation.

CASE DESCRIPTION: The patient for this case report was an adult male referred to physical therapy with chief complaints of neck and shoulder pain. Comorbidities included: idiopathic pulmonary fibrosis (IPF), hypertension, coronary artery disease, neuropathy, parotidectomy, atrial fibrillation, gastrointestinal reflux disease and polyoid adenoma. Clinical findings from examination revealed impairments that fit into the impairment based classification system described by Olson. The therapist classified the patient into thoracic hypomobility paired with (1) upper extremity referred pain, (2) shoulder impairments and (3) neck pain. The therapist then followed the guidelines, treating the patient with manual interventions of neuromobilization, mobilization, manipulation and exercise (including diaphragmatic breathing, thoracic and shoulder exercises).

OUTCOMES: The treatment of manual therapy addressed the patient’s orthopaedic impairments, improved quality of life, and maintained pulmonary function. Outcome measures after 12 treatment sessions included: CareConnections, a web-based functional outcome score, improvement from 86% to 98%, reduction in pain from 4/10 to 0/10 on the visual analog scale (VAS), return to golf and other activities of daily living (ADL) as well as an overall apparent lower than expected hospitalization time and an excellent recovery post lung transplant. Oxygen saturation taken before and after treatment showed improvement at each treatment and cumulatively over time his pulmonary function did not deteriorate as was expected prior to transplant.

DISCUSSION: Through evidence-based practice (EBP), an orthopaedic PT applied a classification method of practice and categorized this patient to utilize an impairment-based approach, while considering the influences of the patient’s cardiopulmonary system. Pulmonary Rehab (PR) should be structured as a multidisciplinary program with a combination of manual therapy, exercise training, education, and behavior modification techniques to optimize functional capacity, improve self-management, decrease symptoms, and increase participation in ADL for patients with chronic lung disease. This case exemplifies the need to follow EBP and delineates an example merging specialty of practice; manual orthopaedic physical therapy and cardiopulmonary physical therapy.


OP0148
A REVIEW OF PITCHING KINEMATICS AT THE MOMENT OF FOOT CONTACT IN YOUTH BASEBALL: 2007 TO 2017
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PURPOSE/HYPOTHESIS: Pitch mechanics are perceived to predict injury along with velocity and count. (Fleisig 2012) 3-D motion capture systems are unavailable in most clinics. Visual analysis of motion (VAM) can occur using readily available 2-D or via unassisted visual observation. Across various tasks, the accuracy of physical therapist’s (PT) VAM of kinematics is impacted by complexity and speed of task. (Knudson 2013) The process of (VAM) requires application of the range of motion required for optimal motion in each defined phase of the task. This rapid review aims to present the published kinematics collected via 3-D motion capture for the moment of front foot contact (Fleisig 1996), in youth to high school-aged individuals to inform PT’s VAM.

NUMBER OF SUBJECTS: Not applicable.

MATERIALS/METHODS: Eligible studies (eg, randomized-controlled trials, narrative reviews, and comparative cohort studies), examining mechanics in the youth to high school-aged healthy pitcher. Standardized search terms for PubMed, Scopus, CINAHL Plus with full text, SPORTDiscus with full text, and Web of Science. Inclusion criteria: literature published from January 2007 to April 2017, English text. Exclusion criteria: age of 19 years or greater, softball, positional players, nonhealthy.

RESULTS: Five hundred thirteen studies were retrieved. 239 titles/abstracts were reviewed after removing duplicates. Sixty-eight full-text articles were assessed. Nineteen studies were retained for intense review. Although data were collected for all 6 phases of pitching; emphasis is on the moment of front foot contact. Of the 19 full-text articles reviewed only 17 reported 3-D kinematic data for front foot contact. Mean angles were widely variable between studies (minimum reported to peak reported). Shoulder (shd) ER angle: 40.93° ± 4.70° to 130° ± 17°; shd abduction 81° ± 8° to 101.7° ± 15.8°; shd horizontal abduction 18.4° ± 15.2° to 25.66° ± 4.84°; stride knee flexion 34° ± 14° to 52° ± 8°; elbow flexion 81.7° ± 16° to 116° ± 11°; stride length as a percent of height 62% to 82% ± 7%.

CONCLUSIONS: Kinematic data are available but incomplete for key regions of the body involved in the pitching motion. Identified studies reporting kinematics via 3-D motion capture vary widely in mean angles across all joints. The significant difference in the mean data further demonstrates the difficulty of pitching analysis via VAM as VAM relies on kinematics for identification of movements which are outside the norm.

CLINICAL RELEVANCE: Published literature presents a large range of mean angles for kinematics during a pitch, complicating the application and interpretation of VAM by the PT. The accuracy of VAM relies on the background knowledge of PT on optimal kinematics and the ability to interpret what is observed. The use of 2-D and the option of slow motion/freeze frame may assist with visualizing the complexity of pitching. Further research is required to appreciate the key regions for VAM for injury prevention/performance. Foci should include: inter/intra-reliability of VAM of pitching by PTs and longitudinal studies for study of pitching mechanics and injury risk.

OP0149
DO INDIVIDUALS WITH VISION IMPAIRMENTS SUFFER PHYSICAL INJURY WHILE USING GUIDE DOGS?
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PURPOSE/HYPOTHESIS: Current literature shows that people who are visually impaired fall more frequently than people who are not visually impaired regardless of what travel aid they use. Current literature also shows that guide dog users are more independent in their activities of daily living (ADLs) than people who are visually impaired who do not use guide dogs. Previous studies have analyzed the relationship between musculoskeletal injuries and long cane use in people with vision impairments. However, the relationship between guide dog use, falls, and musculoskeletal injuries has not been thoroughly explored. The purpose of this study was to examine the relationship between guide dog use with musculoskeletal injuries and fall frequency in visually impaired people.

NUMBER OF SUBJECTS: The Facebook group “Guide Dog Handlers Network” was chosen for this study. Individuals from this group were included in this study if they had visual impairments, English speaking, over the age of 18 and a self-reported guide dog handler. Eighty-two members responded to the survey.

MATERIALS/METHODS: A survey consisting of 27 multiple choice and open-ended questions was distributed to Guide Dog Handlers Network group on Facebook, via Survey Monkey. The informed consent preceded the questionnaire. Before distributing the survey to the Facebook group, the survey was reviewed by an expert panel of 3 guide dog handlers to receive feedback on survey accessibility and wording of questions. In order to receive a variety of feedback, the expert panel consisted of 1 totally blind guide dog handler, 1 legally blind guide dog handler, and 1 guide dog handler with only light perception. All 3 experts reported no accessibility issues that would prevent them from completing the survey independently. The survey was completely anonymous to protect confidentiality. The researches utilized SPSS statistical software to run descriptive statistics and chi square frequency analysis to analyze results of survey responses.

RESULTS: Participants in this study have used guide dogs an average of 5 years. Among these users, complaints of falling reduced from 30% with other mobility aids, to 5% when assisted by a guide dog (P<.05, n = 79).

Conclusions: Complaints of joint pain increased following guide dog use to 61% of respondents, compared to 44% complaints of joint pain in the same population before using a guide dog (P<.05, n = 80).

CONCLUSIONS: This study indicates that guide dog assistance markedly reduces the risk of falling in individuals who are visually impaired. An increase in joint pain complaints was noted in these individuals after changing from other mobility aids to working with a guide dog.

CLINICAL RELEVANCE: Further studies to characterize the nature and extent of these orthopaedic injuries may lead to strategies that may reduce injury to these individuals. Skilled Physical Therapy would be beneficial to this population beginning with the assessment of ergonomic halter handles, postural strengthening and control and ergonomic education to reduce the risk of overuse injuries.

OP0150
IMPLEMENTATION OF COLLABORATIVE PT/MD PRIMARY CARE SERVICE
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BACKGROUND AND PURPOSE: Although physical therapy (PT) triage services for musculoskeletal patients are known, collaborative models working directly with medical doctors (MD) and their staff (physician assistants [PAs]) are new. A collaborative PT/MD model may address primary care MD satisfaction and improve patient management. The purpose of this

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case report is 9 months of data from PTs, MDs, and patients during implementation of a collaborative PT/MD primary care service. The data includes process outcomes (eg, frequency of visits), provider (MD, PA, and PT) survey responses, and patient outcomes (satisfaction and patient acceptable symptom state (PASS)).

CASE DESCRIPTION: In August 2016, 4 therapists combined to provide onsite PT services to 14 family practice and internal medicine physicians and their staff. As of June 2016, 1315 patients (mean ± SD age, 54.7 ± 19.2 years; 63% female) were documented. Initial PT services were observation. Average daily visits increased from 6.7 visits per day in January 2017 to 10.6 visits per day by May 2017. Evaluation services included assisting with diagnosis and necessity of imaging. Treatment services included: exercise approaches (94.1% of visits), patient education (93.9% of visits), and hands on treatment (eg, manipulation) (34.1% of visits). Quarterly, separate PT training and MD training sessions were completed based on monthly visit frequency (percent): spine pain (up to 40%) shoulder pain (up to 25%), and knee pain (up to 18%).

OUTCOMES: A total of 11/14 providers (MD/PA) self identified as frequent users of the service. Providers ranked the service on the “influence on imaging decisions” as 6.7/10 ± 2.9, “influence on treatment decisions” 6.8/10 ± 2.8, and “value PT adds to your service” as 9.2/10 ± 1.8. Similarly, PT’s ranked the “value added to the patient encounter” as 8.2/10 ± 1.9. A total of 113/536 (21%) patients were surveyed by phone between March 2017 and June 2017 with in 7 days of their visit. A total of 50% of the patients rated themselves as at an acceptable level of activity and symptoms (ie, response to PASS question). On a global rating of normal function (0-10) patients rated their involved joint on average as 5.8/10 ± 2.3 (where 10 equals normal function). “Patient satisfaction with the care they received” was ranked as 9.2/10 ± 1.4.

DISCUSSION: This report describes gradual acceptance and integration of a collaborative PT/MD primary care service for musculoskeletal patients. Providers ranked the value of the service as high (greater than 8.2/10). Anecdotally, providers were impressed with the ability of physical therapists to establish a diagnosis, gain an immediate treatment effect and assist with chronic pain patients. Providers were also highly satisfied with the service (greater than 9/10). However, the short-term follow-up (fewer than 7 days) data shows that only 50% of patients are at an acceptable symptom state and an average low global rating of function (5.8/10). These low values support continued monitoring or more frequent care may be necessary. This service shows the potential to improve primary care outcomes.


OP0151
ASYMMETRICAL MOVEMENT PATTERNS IN FEMALE COLLEGIATE DANCERS IDENTIFIED BY THE FUNCTIONAL MOVEMENT SCREEN
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PURPOSE/HYPOTHESIS: Dance participation has increased in the past few decades, along with the prevalence of dance-related injuries. Recent literature has suggested imbalances between right- and left-sided movement patterns may increase risk for injury. A lateral bias is common in competitive dancers due to performing repetitive 1-sided movements during practice and competitions. Physical therapists often use screening tools such as the Functional Movement Screen (FMS) to determine the presence of asymmetries between the right and the left sides of the body. The primary purpose of this study was to determine if the FMS is appropriate for detecting asymmetries in a dance population. The secondary aim was to establish normative profiles of FMS scores in competitive dancers.

NUMBER OF SUBJECTS: Twelve female participants with 15.75 ± 2.63 years of dance experience, aged 18 to 22 years old, on a Division II collegiate dance team.

MATERIALS/METHODS: Each dancer completed the FMS as described by Cook, including the Deep Squat, Hurdle Step, Incline Lunge, Shoulder Mobility, Active Straight-Leg Raise, Trunk Stability Pushup, and Rotary Stability. Each of the 7 movement patterns were scored from 0 to 3 points, with the sum creating a score ranging from 0 to 21 points.

RESULTS: Of the 12 dancers who participated, 9 demonstrated at least 1 asymmetry during some component of the FMS. Freshmen dancers demonstrated the most number of asymmetries (5/6 dancers), and senior dancers demonstrated the least asymmetries (1/3 dancers). The average FMS score for freshmen was 14.8, sophomores and juniors was 15.0 and seniors was 16.7.

CONCLUSIONS: Asymmetrical movement patterns were a common occurrence in this group of collegiate dancers. The average score for FMS, as well as the number of asymmetries, improved based on years of college dance team experience. Further investigation is warranted to determine if these asymmetries are considered a normal occurrence in a larger population of dancers, and if they place the dancer at risk for injury. Whether dance-specific workout programs should be developed to decrease musculoskeletal asymmetries as identified by the FMS in dancers is unclear.

CLINICAL RELEVANCE: Clinicians should consider screening dancers for asymmetries using the FMS and future research should focus on predictive value of this screening tool in determining risk of musculoskeletal injury.

OP0152
PEOPLE LIVING WITH BACK PAIN RECEIVING GUIDELINE-BASED PHYSICAL THERAPY CARE INTEGRATED WITH THE STANFORD CHRONIC PAIN SELF-MANAGEMENT PROGRAM: EFFECTIVENESS ON DISABILITY AND PAIN INTERFERENCE
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PURPOSE/HYPOTHESIS: The primary aim of this study was to compare the effectiveness of clinical practice guideline (CPG) informed PT care used in isolation versus PT integrated with the peer-led Stanford Chronic Pain Self-Management Program (PT+CPSMP) on disability and pain interference for people living with low back pain (LBP). The secondary aim was to evaluate the extent to which health beliefs and behaviors modify disability. We hypothesize that the effectiveness on reducing disability and pain interference with the integrated treatment arm (PT+CPSMP) will be greater than PT delivered in isolation for those individuals with higher baseline disability levels.

NUMBER OF SUBJECTS: Twenty-four (12 PT, 12 PT+CPSMP).

MATERIALS/METHODS: Adult participants seeking PT treatment for a primary complaint of LBP were eligible for enrollment, and allocated to receive either PT or PT+CPSMP based on a shared decision making model. Participants received either 6 weeks of PT informed by the US CPG for LBP or 6 weeks of PT+CPSMP. The peer-led CPSMP (15 hours total) provides pain and health education, problem-solving and action planning. All leaders of the PT intervention held clinical doctorate degrees, board certification in orthopaedics, and competency in the CPG for LBP. Participants received the Roland-Morris Disability Questionnaire, NIH PROMIS item banks for Physical, Mental, and Social Health, Pain Self-Efficacy Questionnaire (PSEQ), Tampa Scale of Kinesiophobia (TSK), Stanford Expectations of Treatment Scale, Stanford Exercise Behavior Scale, and Stanford Communication with Health care Provider Questionnaire. All primary measures were administered at 3 time points: baseline, 6 weeks, and 18 weeks. The PSEQ and TSK were administered at baseline, 3 weeks, and 6 weeks to assess for potential moderating effects on disability and pain interference. This study was approved by the Stanford University IRB.

RESULTS: Enrollment is complete, and all participants have completed both treatment arms. Data are presently under analysis.
CONCLUSIONS: No evidence currently exists which supports the effect size on reducing disability for the more recently developed 2012 US PT CPG for LBP, nor for the more recently updated 2015 Stanford CPSMP. PT care as a standalone treatment may have limitations in that they are not fundamentally grounded in enhancing self-efficacy through problem-solving and decision making. The Stanford self-management programs have previously demonstrated strong evidence of increased long-term confidence with self-care, improved health behaviors, and reduced distress and depression.

CLINICAL RELEVANCE: This effectiveness pilot trial provides high external validity, researches patients treated in current clinical practice, and selects patients likely to receive treatment as part of care. This pragmatic study will provide preliminary evidence of a novel pathway in which PT can work together with self-management programs to provide further support for people living with back pain.

OP0153

A deeper understanding: choosing an exercise self-efficacy scale for college-aged wellness clients

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PURPOSE/HYPOTHESIS: There have been numerous calls to improve health and wellness in all populations. One third of the college-aged population do not meet federal physical activity guidelines for exercise behaviors.

Physical therapists (PT) have a unique opportunity as a bridge between rehabilitation and preventive wellness.

Exercise is a typical intervention in either role. There is strong association between self-efficacy and exercise behaviors, particularly in the college-aged population (CAP).

The majority of scales measuring exercise self-efficacy (ESE) may not be appropriate for use in the CAP due to varying life circumstances, perceptions, and personal values. Increased emphasis on investigating ESE subcategories, such as scheduling, task, and coping/barriers, through validated outcome measures may help clinicians better understand how to improve physical activity participation and adherence.

The purpose of this review was to examine the literature for exercise self-efficacy scales appropriate for use in a healthy, college-based population.

NUMBER OF SUBJECTS: Not applicable.

MATERIALS/METHODS: Databases included SCOPUS, PubMed, CINAHL, SportsDiscus, and PsyCINFO. Searches were conducted using a standardized search string without filter for year. Study inclusion criteria: reported on a self-efficacy measure related to exercise or a derivative, reported on healthy, college-based population, English language, with full text available. Studies were excluded if they used individuals with a medical diagnosis, individuals with learning disabilities, or if the specific ESE scale was not identified in the title/abstract (eg, scale title by original author, number of items, and/or year). Both authors reviewed the studies for inclusion/exclusion.

RESULTS: Two thousand one hundred forty-six studies were retrieved and 1548 titles/abstracts were reviewed after duplicates removed, with 19 articles meeting the inclusion/exclusion criteria. A total of 11 exercise self-efficacy scales were identified; 6 scales pertained to coping/barriers related to exercise self-efficacy and 5 were classified as scheduling, task, or other. While all scales showed high overall reliability, validity was variable.

CONCLUSIONS: This review supports that several ESE scales are valid and reliable for use in a healthy, college-based population. The lack of clear study methods on outcome measure reliability, changing ESE nomenclature, and numerous modified versions of previous scales may result in challenges for the PT to select ESE scales for the healthy, college-aged client.

CLINICAL RELEVANCE: As PTs engage the healthy population in preventative and wellness activities, measures of exercise self-efficacy can aid the PT in identifying additional barriers to movement. This review informs the PT and is consistent with the APTA’s strategic plan to transform society as the profession pushes towards the future of health, wellness, and disease prevention.
SURFACE ELECTROMYOGRAPHY OF THE INTERNAL AND EXTERNAL OBLIQUE MUSCLES DURING ISOMETRIC TASKS TARGETING THE LATERAL TRUNK: IS THE LATERAL PLANK THE BEST OPTION?

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PURPOSE/HYPOTHESIS: High levels of trunk muscle activation are considered integral for core strengthening and stabilization. Interestingly, few electromyographic (EMG) studies have directly evaluated tasks, such as the lateral plank, aimed at activating the lateral trunk muscles. Thus, the primary purpose of this study was to compare internal and external oblique activation between 4 isometric tasks using surface EMG. It was hypothesized that while the lateral plank would activate the oblique musculature, other tasks would yield greater activation.

MATERIALS/METHODS: Surface EMG for 2 maximum voluntary contraction (MVC) trials and 4 isometric tasks were collected bilaterally (Telemyo, Noraxon USA, Inc; 1500 Hz). Per previous literature, electrodes were placed over the internal and external obliques. Separate MVC trials for the muscle groups were captured for normalization. The 8 task conditions (4 bilateral tasks) were randomized. In short, testing was conducted for: traditional sidelying hip abduction, lateral plank, sidelying pelvic lift with the feet passively elevated (Greene method), and sidelying modified Sorensen lift with the legs and pelvis stabilized. Each task was held for 5 seconds, with the middle 3 seconds exported for postprocessing using custom MATLAB code. Data were high-pass filtered (15 Hz), demeaned, rectified, low-pass filtered (6 Hz), and then integrated. Conditions were compared using a side-by-side, repeated measures analysis of variance (α = .05) with Bonferroni adjustment with planned comparisons between tasks.

RESULTS: All 4 muscles produced significant task effects (P < .001). The right and left internal obliques, the Greene method and modified Sorensen were comparable (P > .849) and produced the highest levels of activation (P < .001), followed by the lateral plank (P < .001). For the right and left external obliques, the modified Sorensen produced the highest levels of activation (P < .001), followed by the lateral plank (P < .001), followed by the Greene method (P < .001). Across all testing, sidelying hip abduction minimally activated the lateral trunk muscles.

CONCLUSIONS: The sidelying modified Sorensen task consistently yielded the highest activation of the internal and external obliques. Regarding the internal obliques, the Greene method also elicited high activation, followed by the lateral plank. When targeting the external obliques, the lateral plank was superior to the Greene method, but did not activate on par with the modified Sorensen.

CLINICAL RELEVANCE: In this study, the most demanding task for the lateral trunk muscles was the modified sidelying Sorensen method. However, this task requires stabilization of the legs and pelvis. For home exercise programs, the lateral plank is adequate, but does not strongly activate the internal obliques.

THE ROLE OF THERAPEUTIC ALLIANCE IN PHYSICAL THERAPY FOR CHRONIC MUSCULOSKELETAL PAIN: A SYSTEMATIC REVIEW

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PURPOSE/HYPOTHESIS: The purpose of this systematic review was to determine the specific impact of therapeutic alliance (TA) on chronic musculoskeletal pain, identify the elements that influence TA between the physical therapist and individuals with chronic musculoskeletal pain, and determine the working definition of TA across studies.

NUMBER OF SUBJECTS: Included studies met the following criteria: (1) Study population of adults with chronic musculoskeletal pain (pain lasting 3 months or more); (2) Interventions assessing or manipulating the “therapeutic alliance,” the “professional-patient relationship,” “helping alliance,” or “working alliance”; (3) Any pain-management physical therapy intervention; (4) Studies including randomized control trials, cohort trials, observational trials, case series, and mixed model studies; (5) Outcome measures associated with pain, physical function, disability, therapeutic or working alliance, or number of physical therapy visits.

MATERIALS/METHODS: For this review, 3 databases were targeted: PubMed, CINAHL, and Embase. Title, abstract, and full text screens were performed. Risk of bias of individual studies was assessed using Cochrane methodology. The authors reviewed each study included for data extraction using a PEOT (population, exposure, outcomes, type of study) approach.

RESULTS: Three studies offered quantitative data suggesting that a strong TA coupled with physical therapy resulted in improved pain outcomes compared to physical therapy interventions alone. Findings from 5 observational studies identified factors that positively and negatively influe-
Enhanced the strength of the TA. Operative definitions of TA were identified across all studies. Six of the 8 studies had a high risk of bias, 1 had moderate risk of bias and 1 had low risk of bias.

**CONCLUSIONS:** Emerging evidence suggests that for individuals with chronic musculoskeletal pain, a strong TA may improve pain outcomes. Common factors that positively influenced TA were trust and the development of individualized treatment plans. Based on the working definitions of TA across the studies included in this review, we recommend the expansion of the TA definition to include enhanced communication.

**CLINICAL RELEVANCE:** Emerging evidence indicating a positive impact of TA on pain outcomes for patients with chronic musculoskeletal pain suggests that TA deserves attention in the rehabilitation setting. In order to offer the highest quality of care to patients with chronic musculoskeletal pain, physical therapists must become skilled at addressing psychosocial barriers to healing in addition to physical impairments. Communication training available for health care professionals can help cultivate skills in efficiently building strong TA with patients.

**OP0159**

**THE SUCCESSFUL TREATMENT OF COMPLEX REGIONAL SYNDROME WITH PAIN EDUCATION AND PHYSICAL THERAPY**

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**BACKGROUND AND PURPOSE:** Chronic pain affects over 100 million people in the United States and is extremely challenging to treat. Research shows that educating patients on the biological processes that underpin chronic pain can have positive effects. This case study will demonstrate that patient education addressing the neurophysiology and neurobiology of pain, referred to as Therapeutic Neuroscience Education (TNE), can decrease pain, disability, and catastrophization, and enhance mobility in a patient with chronic pain, when paired with traditional physical therapy (PT).

**CASE DESCRIPTION:** The patient is a 50-year-old woman with a 4-year history of Complex Regional Pain Syndrome without a precipitating factor affecting her left leg. She had previously received traditional PT, epidural injections, and a sympathetic block, but none provided relief. She had never received formalized pain education, such as TNE. Key concepts of TNE include nociception, sensitization, and understanding the biological processes of pain. Education was provided using stories, metaphors, and pictures meant to be memorable by provoking an emotional response. These concepts were continually reinforced to normalize pain beliefs while the patient completed a traditional PT program including stretching and range of motion exercises, graded weight-bearing, gait training, aerobic activity, strengthening, and balance. Compliance, a barrier for many patients with chronic pain, was addressed by maintaining a written exercise log. Self-regulation and energy conservation were addressed through instruction on activity modification and sleep hygiene guidelines.

**OUTCOMES:** Outcome measures such as gait speed (GS), the timed up and go (TUG), 5-times sit-to-stand (5xSTS), and the 6-minute walk test (6MWT) were assessed at evaluation, 3 months into treatment and 6 months into treatment. Additionally, the patient completed the Lower Extremity Functional Scale (LEFS) and the Pain Catastrophizing Scale (PCS) at evaluation and again at 6 months. Significant improvements were seen across all outcome measures. Patient’s gait speed increased from 0.20 m/s to 0.32 m/s to 0.52 m/s. TUG time decreased from 40 seconds to 27 seconds to 13 seconds. FTSST time decreased from 54s to 35 seconds to 26 seconds. The patient progressed from being unable to finish the 6MWT to evaluation to completing 433 feet after 6 months. Additionally, her PCS improved from 19/54 to 14/54 and LEFS improved from 9/80 to 23/80, both signifying enhanced quality of life.

**DISCUSSION:** The outcomes of this case demonstrate that incorporating pain education into PT is feasible for an outpatient setting and can produce dramatic results. While this patient had received PT in the past, it had not been effective. Research has shown that teaching people about the biology of chronic pain can produce a range of positive effects, including increasing the pain threshold during physical tasks, normalizing pain beliefs and attitudes, and improving pain and disability outcomes when combined with therapeutic interventions.

QUADRICEPS RATE OF TORQUE DEVELOPMENT PREDICTS KNEE FLEXION MECHANICS DURING WALKING AFTER TOTAL KNEE ARTHROPLASTY
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PURPOSE/HYPOTHESIS: Following physical therapy for total knee arthroplasty (TKA), significant deficits persist in knee flexion excursion (KFLEXC) which contributes to functional impairments and reduced quality of life. Assessment of walking mechanics in a clinical setting is challenging and a strong need persists to identify early muscle strength and functional tests that are predictive of KFLEXC 6 months after TKA. Thus, the purpose of this study is to determine the utility of clinical assessments performed 3 months after TKA in predicting KFLEXC during walking at 6 months after TKA.

NUMBER OF SUBJECTS: Forty-four total subjects (24 TKA, 20 matched controls); TKA: 6 male, 18 female; height, 1.67 ± 0.08 m; mass, 89.35 ± 20.2 kg; BMI, 32.7 ± 7 kg/m²; age, 59.9 ± 8.2 years; control: 6 male, 14 female; height, 1.68 ± 0.1 m; mass, 78.71 ± 21.3 kg; BMI, 30.6 ± 5.6 kg/m²; age, 60.2 ± 7.9 years.

MATERIALS/METHODS: Subjects performed isometric strength testing to determine peak strength and rate of torque development (RTD) of hip abductor, hip external rotator (ER), and quadriceps muscle groups. Hip ER and quadriceps testing was performed with the subject seated and knee flexed to 90°. Hip abduction was assessed in sidelying with the hip in a neutral position. RTD was calculated as the slope of the linear rise in the torque-time curve after trial initiation. Subjects also performed the 5x5STS test (FTSTS) and underwent 3-D motion analysis while walking at a self-selected speed (0.9 ± 0.2 m/s) on an instrumented treadmill. Joint angles were calculated for the stance phase. Subjects in the TKA group underwent strength and functional testing at 3 months post TKA and completed the gait analysis at 6 months post TKA. Pearson product-moment correlations and stepwise multiple linear regression were used to assess the relationships and predictive properties of muscular strength and functional measures to 6 month KFLEXC measures.

RESULTS: Peak hip abduction strength (r = 0.308, P = 0.045), peak hip ER strength and RTD (r = 0.438, P = 0.003; r = 0.388, P = 0.009), peak quadriceps strength and RTD (r = 0.608, P = 0.000; r = 0.612, P = 0.000), and the FTSTS (r = -0.398, P = 0.007) were significantly correlated with KFLEXC. Quadriceps RTD solely predicted KFLEXC at 6 months post TKA (adjusted R² = 0.374, P ≤ 0.001).

CONCLUSIONS: Faster quadriceps RTD at 3 months post TKA is predictive of greater KFLEXC during walking at 6 months post TKA while hip strength and functional performance are not. Recovery of quadriceps muscle performance near the conclusion of rehabilitation may lead to more normal knee joint motion during walking after TKA and improve postoperative quality of life.

CLINICAL RELEVANCE: Rehabilitation after TKA should emphasize recovery of quadriceps function, specifically maximizing RTD to allow for rapid production of knee extensor torque, in order to restore normal knee joint motion during walking. As a result of this work, later phases of rehabilitation should focus on improving quadriceps performance in order to prepare patients for an optimal postoperative quality of life.

USE OF VIDEO IN CLINICAL MOVEMENT ANALYSIS: CURRENT PRACTICES AND PERSPECTIVES OF PHYSICAL THERAPISTS

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PURPOSE/HYPOTHESIS: Observational movement analysis is a critical part of PT practice, but it is often imprecise and is only moderately reliable. One inexpensive, accessible way to improve movement analysis is through video recording; however, it is not clear how PTs use video assessments in practice. This study aims to investigate current practices and perspectives of PTs regarding the use of video in movement analysis.

NUMBER OF SUBJECTS: One thousand one hundred fourteen.

MATERIALS/METHODS: An online survey link was distributed via email to members of APTA sections (Orthopaedic, Sports, Pediatric, and Neurology) and state chapters of CA and NY. The survey consisted of 25 closed-ended questions regarding PT and patient demographics and practice settings; current video use (frequency, procedures, and technology); and views regarding perceived benefits and barriers to using video. Percentages of responses in each category were calculated for each survey item.

RESULTS: One thousand one hundred forty practicing PTs completed the survey. A majority of respondents worked in orthopaedics/sports (1200) and/or in outpatient clinics (1242); the following data represent outpatient orthopaedic/sports PTs only (n = 1114). Overall, 61% of respondents collect video data for patient assessment; however, 84.5% of these do so with fewer than 25% of patients. For those who use video, the most common tools are smartphones (79.5%) and tablets (46.7%), and 63.3% of PTs use specialized analysis software. The most commonly recorded tasks are running (83.2%), gait (76.4%), sport-specific movements (61.3%), and other functional movements (49.2%). PTs often take advantage of video to view movements using slow motion (89.4%), replay (80.3%), and pause (81%).

CONCLUSIONS: Clinicians can use this information in designing lower extremity strength and neuromuscular training programs.
mments (93.7%), increasing accuracy of movement assessment (86.5%), and being able to attend to multiple components of a movement (77.6%) are the biggest benefits of video. For PTs who use video, the most common barriers to greater use are lack of time (43%) and concerns about patient privacy (26.5%); for PTs who do not use video, lack of technology (49.9%), lack of time (46%), and patient privacy (34.3%) were common concerns.

CONCLUSIONS: Although video analyses are currently used by a majority of outpatient orthopaedic PTs, most use video infrequently. PTs tend to employ video to improve qualitative assessments of movement, with few taking advantage of video's ability to facilitate quantitative, standardized assessments. Lack of time and technology are the biggest barriers to use.

CLINICAL RELEVANCE: Gaining insight into the perspectives of clinicians can inform future efforts to develop tools and protocols for collecting and analyzing video in the clinic, with the aim of improving precision and reliability of PT assessment. Our results suggest that what are particularly needed are video recording and analysis tools that facilitate quick, objective assessments of movement.

**OP0163**

**EFFECTS OF GASTROCNEMIUS/SOLEUS SELF-MYOFASCIAL RELEASE VERSUS DYNAMIC GASTROCNEMIUS/SOLEUS STRETCHING ON CLOSED-CHAIN DORSIFLEXION**

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**PURPOSE/HYPOTHESIS:** Limited ankle dorsiflexion (DF) range of motion (ROM) is often correlated with decreased flexibility of the gastrocnemius/soleus (GS) complex. This decrease in ankle DF ROM can lead to an increase in lower extremity injuries. The purpose of this study was to determine whether ankle DF was improved after intervention to the GS complex via multidirectional self-myofascial release using a foam roller (FR), multiplanar dynamic stretch performed in downward dog (DD), or a combination of both techniques (CT).

**NUMBER OF SUBJECTS:** Forty-two physical therapy students (18 female, 24 male) with mean ± SD age of 26.12 ± 4.03 years voluntarily consented to participate in this convenience sample study.

**MATERIALS/METHODS:** Following acquisition of informed consent, a standardized video demonstrating the intervention techniques was sent to all subjects 1 week prior to data collection. All subjects were asked if they had any questions about the techniques before beginning the data collection. Subjects were randomly assigned to the FR, DD, or CT via random card selection. All were then verbally cued for correct positioning and performance in foam rolling and downward dog activities. Both interventions were performed twice in 1 minute with a dynamic walking rest for 1 minute between interventions. Weight-bearing right ankle DF measurements were taken preintervention and postintervention using a forward lunge technique; values were acquired in centimeters (ICC = 0.97 and 0.96). A dependent t test was performed for each intervention group to assess within-group differences. A 1-Way ANOVA was performed to assess between group differences; (P < .05). An a ≤ .05 was selected for significance; all data were analyzed using SPSS Version 24 software.

**RESULTS:** No significant difference was found between FR, DD, or CT (P = .551). However, a significant improvement from baseline measurement was found within all 3 treatment groups: FR P = .037, DD P = .005, CT P = .031. Mean ± SD measurements from pretest to posttest for FR, DD, and CT interventions were: 0.479 ± .773, 0.700 ± 0.778, 0.907 ± 1.41, respectively.

**CONCLUSIONS:** Multidirectional myofascial release, multiplanar dynamic stretching, and a combination of the 2 exercises were all shown to significantly improve DF ROM. However, there was no significant difference between the 3 groups.

**CLINICAL RELEVANCE:** The results of this study reinforce the clinical application of myofascial release and dynamic stretching to increase DF ROM, either individually or in combination. Clinicians can incorporate either technique within their treatment plan to increase DF ROM and GS complex extensibility.

**OP0164**

**THE EFFECT OF PROPRIOECEPTIVE NEUROMUSCULAR FACILITATION ON PAIN, ROM, AND FUNCTION IN ORTHOPAEDIC SHOULDERS PATHOLOGIES: A SYSTEMATIC REVIEW**

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**PURPOSE/HYPOTHESIS:** The purpose of this systematic review was to compare the effectiveness of PNF to conventional physical therapy interventions in the treatment of patients with musculoskeletal dysfunction related to orthopedic shoulder pathology.

**NUMBER OF SUBJECTS:** Not applicable.

**MATERIALS/METHODS:** The following search engines were used to perform a comprehensive literature search to identify relevant PNF studies related to orthopaedic shoulder pathologies: Cochrane library, APTAs Hooked on Evidence, NCBI/PubMed, PEDro, and ProQuest from November 2015 to January 2016. Article inclusion criteria included: studies investigating orthopaedic shoulder pathologies, utilization of PNF as an intervention to treat musculoskeletal impairments, improvement in shoulder function measured by an upper extremity outcome measure, randomized controlled trials (RCTs), and participants between the ages of 18 and 85 years. Article exclusion criteria included: non-peer-reviewed studies, pathologies with any neurological involvement or did not use an outcome tool that measured function. Four reviewers using the PEDro scale evaluated the quality of selected articles.

**RESULTS:** Eight randomized control trials were selected and analyzed. All studies characterized PNF as effective in treatment of deficits related to orthopaedic shoulder pathology. Results were specifically narrowed to include the following outcome measures: pain reduction using the VAS, range of motion, overhead reach, and the shoulder pain and disability index (SPADI). Seven of the 8 randomized control trials showed positive outcomes resulting from PNF intervention in 1 or more of the outcome measures when compared with conventional treatment. Five of the studies demonstrated significant improvements in shoulder ROM, 4 relieved significant decreases in pain levels, and 4 indicated significant increase in SPADI scores or overhead reach. The average article PEDro score of those articles studied was 4.9.

**CONCLUSIONS:** The results of this systematic review suggest PNF compares favorably to other frequently used physical therapy interventions when treating impairments related to musculoskeletal disorders. Further, during the development of the present abstract, no systematic reviews specifically addressing PNF as the treatment of choice for orthopaedic shoulder pathology were found. However, the present studies do appear to support the continued use of PNF techniques as an adjunct in addressing shoulder dysfunction related to orthopaedic pathologies. Improvements in patient pain intensity, outcome measure scores, and range of motion of the shoulder girdle were noted throughout.

**CLINICAL RELEVANCE:** Acquisition of further high quality evidence is recommended to help reinforce PNF use as a viable shoulder treatment option and to help to clarify which PNF techniques are most applicable in addressing specific orthopaedic shoulder pathologies.

**OP0165**

**MANIPULATION AND EXERCISE FOR TREATMENT OF CHRONIC MIGRAINE AS AN ALTERNATIVE INTERVENTION FOR PATIENTS PREVIOUSLY PRESCRIBED OPIOID ANALGESICS: A CASE SERIES**

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**BACKGROUND AND PURPOSE:** Migraine is a widespread neurological disease affecting 38 million people in the United States. Despite recommenda-

OPI166

APPLICATION OF A MOTOR SKILL TRAINING PROGRAM IN AN INDIVIDUAL WITH CHRONIC LOW BACK PAIN
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BACKGROUND AND PURPOSE: Chronic low back pain (LBP) is a condition that impacts function. The primary reason people with chronic LBP seek medical care is trouble performing daily activities. Additionally, individuals with LBP demonstrate symptom-provoking altered patterns of movement and alignment during performance of daily activities. As such, motor skill training (MST) is a practical approach to improving performance and decreasing pain during daily activities. The goal of MST is to train people to modify the patterns of movement and alignment they use to perform daily activities without pain. The training is structured to facilitate motor learning through challenging practice of daily activities emphasizing attention to intrinsic feedback and patient problem solving. This novel approach to musculoskeletal pain directly addresses the problematic daily activities. The purpose of this case report is to describe short- and long-term outcomes of a MST program in a person with chronic LBP.

CASE DESCRIPTION: The patient was a 26-year-old man who presented following 10 years of LBP. He described pain and limitation performing daily activities. The purpose of this case report is to describe short- and long-term outcomes of a MST program in a person with chronic LBP.

CASE DESCRIPTION: Both patients reported improvement in symptoms and pain-related disability, and exhibited improvement in mobility, motor function and posture. Cervical spine and temporomandibular dysfunction and mechanical stress have been reported as contributing factors to headache. Distorted sensory input from cervical and temporomandibular structures transmitted via the cervicotorigeminal pathway and processed in the trigeminal nucleus caudalis has been proposed as a factor for the temporal and symptomatic features of migraine. Nociceptive afferent overload from dysfunctional cervical and temporomandibular structures has been linked to central hypersensitivity and influencing migraine triggers. Interventions focused on optimizing functionality of the cervical and temporomandibular structures have the potential to positively impact migraine symptoms. The outcome of this study suggests that manipulation and exercise may be an effective alternative intervention to opioid analgesics; however additional research by random control trial is needed.

Combined Sections Meeting


**OP0167**

**CLINICIAN EXPECTATIONS OF FULL-THICKNESS ROTATOR CUFF REPAIR OUTCOMES**

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**PURPOSE/HYPOTHESIS:** Up to 300 000 people undergo elective rotator cuff repair surgery (RCRS) in the U.S. each year. Patients commonly overestimate their expected outcomes after elective orthopaedic surgery and rely on clinicians to educate them in the decision-making process. In order to improve patient education standards, a better understanding of clinician expectations is needed. The purpose of this study is to examine clinician expectations of outcomes after full-thickness RCRS, and whether expectations differ between clinician experience level and shoulder caseload percentage.

**NUMBER OF SUBJECTS:** Seven hundred four licensed physical therapists.

**MATERIALS/METHODS:** Clinicians were surveyed from the Orthopaedic Section of the American Physical Therapy Association and local physical therapy clinics. An 18-question survey using a modified Likert scale assessed demographics, time spent reading literature, and expected outcomes of RCRS 1 to 2 years after surgery. Clinicians were dichotomized by experience level (greater than 10 years [A] and 0-10 years [B]) and percent of shoulder caseload (greater than 30% [C] and 0%-30% [D]). Descriptive statistics and chi-square tests were used to report overall expectations and differences between groups.

**RESULTS:** Of the clinicians surveyed, 72.5% expected full range of motion, 67.8% expected full strength, 79.3% expected full function, 51.7% expected minimal to moderate risk of re-tear and 97.0% expected minimal to no pain. There were no significant differences between clinician experience group A and B responses regarding expectations of minimal to no pain (A, 97.5%; B, 96.2%; $P = .665$); return to full function (76.7%, 82.0%; $P = .060$); expected full range of motion (71.0%, 72.0%; $P = .900$); expectation of full strength (66.8%, 68.6%; $P = .386$) and expectation of minimal to moderate risk of re-tear (53.7%, 47.4%; $P = .375$). A significant difference was seen in expectation of return to full strength between percentage shoulder caseload groups C and D (72.3%, 64.9%; $P = .039$). No significant differences were found between groups C and D responses in expectations of minimal to no pain (C, 95.8%; D, 97.2%; $P = .327$), return to full function (78.7%, 79.1%; $P = .900$); expected full range of motion (73.1%, 71.5%; $P = .651$), and expectation of minimal to moderate risk of re-tear (55.9%, 49.0%; $P = .076$).

**CONCLUSIONS:** Results of the survey indicate that most clinicians overestimate positive outcomes (except for pain) following RCRS with respect to the literature. Neither clinician experience level nor percent of caseload comprised of shoulder patients influenced expected outcomes. Range of motion, strength, function, and risk of retear appear to be areas of patient education that can be improved. Interventions to reduce the gap between research and clinical practice are needed to maximize patient outcomes and satisfaction.

**CLINICAL RELEVANCE:** Clinicians commonly overestimated the expected outcomes after RCRS regardless of experience level or percentage of shoulder caseload treated. The gap between clinician expectations and published outcomes may influence clinician ability to provide accurately informed patient education.

**OP0168**

A MOVEMENT SYSTEM APPROACH FOR CLINICAL PRACTICE

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**ABSTRACT BODY:** The APTA White Paper of August 2015 (White Paper) calls on physical therapists (PTs) to embrace their role as movement system practitioners with “the expertise to examine, diagnose, and treat all elements of this system to produce a meaningful change in an individual’s movement behavior and physical function.” We would like to propose an approach to evaluation, assessment and treatment that embraces complex human functional training from the start while simultaneously acknowledging the vital perspective of the biopsychosocial model. The GYROTONIC method (GM) has been in practice worldwide for decades, yet traditionally has been associated with dancers and gymnasts only. This does a disservice to a system that has many layers and offers practitioners a scientifically based approach for “optimizing movement to improve the health of society.” As articulated in the White Paper, we, as PT practitioners, acknowledge the complexity of the human body; yet many continue to treat musculoskeletal diagnoses in a compartmentalized fashion with the hope that such interventions translate to function. However, evidence is not strongly in support of this notion. Lumbar stabilization exercises—a series of largely static exercises in pelvic neutral that focus on the isometric cocontraction of the transversus abdominus and multifidus muscles—exemplify this compartmentalization. “Static” and “neutral” are 2 descriptors that have little to do with the participation-level of functioning described by the World Health Organizations’ ICF. Therefore, why continue to rehabilitate dancers and all human movers using the abovementioned exercises? Current literature recommends a dynamical systems approach to explain movement variability. The GM fosters motor learning by varying the environmental constraints of tasks to teach individuals how to make pain- and fear-free, biomechanically-efficient choices to reach full functionality. Fundamental to the GM is balanced and coordinated movement of the trunk and extremities in all 3 planes of motion—the definition of core stability. Foundational to the GM is diaphragmatic breathing. Additional rhythms, intensities and patterns of breathing may be applied: (1) to optimize complex axial movement along the stability/mobility continuum and (2) to modulate the autonomic nervous system. For this poster presentation, we will illustrate GYROTONIC movement sequences to retrain 2 extension-based movement demands in dance, the cambre and arabeque, when recovering from a low back injury. We will depict how the GM teaches the maintenance of spinal integrity throughout the full range of movement. With current literature questioning traditional beliefs in both understanding pain sources and pain-relief mechanisms, our profession is shifting to an active, educational, movement-based treatment approach. The principles of the GM complement this shift and our experience suggests future outcomes research in this domain will validate the method’s effectiveness in rehabilitation settings.

**OP0169**

THORACIC NONTHRUST MOBILIZATION/MANIPULATION TO MANAGE A PATIENT WITH SCAPULAR PAIN FOLLOWING A VERTEBRAL ARTERY DISSECTION: A CASE REPORT

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BUILDING A BETTER GLUTEAL BRIDGE: ELECTROMYOGRAPHIC ANALYSIS OF HIP MUSCLE ACTIVITY DURING MODIFIED SINGLE-LEG BRIDGES


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PURPOSE/HYPOTHESIS: Gluteal strength plays a role in injury prevention, normal gait patterns, eliminating lower extremity pain, and enhancing athletic performance. Research shows high gluteal muscle activity during a single-leg bridge compared to other exercises for gluteal strengthening; however, prior studies have only measured muscle activity with the active lower extremity in 90° of knee flexion. Hamstring cramping, which may impede optimal gluteal strengthening, has been reported during this standard exercise position. Alterations to the single-leg bridge exercise may result in more efficacious gluteal muscle outcomes. Therefore, the purpose of this study was to determine a modified single-leg bridge position that preferentially activates the gluteus maximus and gluteus medius.

NUMBER OF SUBJECTS: Twenty-eight subjects (16 female, 12 male) were recruited for this cross-sectional study from a population between 18 and 30 years of age (average ± SD age, 23.4 ± 2.3 years).

MATERIALS/METHODS: Following familiarization and surface electrode placement on gluteal and thigh muscles, subjects performed a 5-minute warm-up on a stationary bicycle prior to performing 5 variations of the single-leg bridge. Bridge variation order was randomized, and the data collector was blind to the position being performed. Subjects were blinded to the electromyographic (EMG) activity of their working hip muscles. Subjects performed 8 repetitions of each bridge variation to the beat of a metronome set at 60 beats per minute. EMG data were collected as subjects performed maximum voluntary isometric contractions of the muscles of interest and 5 variations of the single-leg bridge. Repeated measures analyses of variance with Bonferroni corrections were performed for each muscle tested in the 5 bridge variations. An alpha level of .05 was used. SPSS Version 23 was used for data analysis.

RESULTS: Hamstring activity was minimized in positions B, in which the dominant knee was flexed to 135° instead of 90° as in the traditional bridge position. This position appeared to preferentially activate both gluteal muscles, as gluteus medius and glutaeus maximus activation (47.35% and 57.23%; MVIC for the gluteus maximus and glutaeus medius, respectively) surpassed and nearly doubled biceps femoris activation (24.11% MVIC).

CONCLUSIONS: The modified single-leg bridge position with 135° of knee flexion (position B) displayed preferential activation of the glutaeus maximus and gluteus medius. This position maintained similarly high gluteal activity while significantly decreasing biceps femoris activity compared to the traditional single-leg bridge position.

CLINICAL RELEVANCE: The modified single-leg bridge position with increased knee flexion to 135° on the dominant side may allow more optimal training of the gluteal muscles than the traditional bridge position since gluteal activity is maintained and the biceps femoris is less likely to be the limiting muscle of the exercise.
THE EFFECTIVENESS OF VIRTUAL REALITY AS AN INTERVENTION TO DECREASE CHRONIC LOW BACK PAIN IN ADULTS AS COMPARED TO STANDARD THERAPEUTIC INTERVENTION: A SYSTEMATIC REVIEW

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PURPOSE/HYPOTHESIS: To determine the effectiveness of virtual reality (VR) as an intervention to decrease chronic low back pain (LBP) in adults as compared to conventional physical therapy (PT) intervention.

NUMEROF SUBJECTS: Not applicable.

MATERIALS/METHODS: A literature search of MEDLINE/PubMed, ProQuest, CINAHL, Cochrane Library, and ScienceDirect was conducted using search terms: (virtual reality OR VR OR virtual reality gaming OR gaming) AND (back pain OR chronic back pain OR low back pain OR LBP). Search limits included: English language and human subjects. Selection criteria included: diagnosis of chronic low back pain (greater than 2 months), adults 18 years and older, randomized controlled trials (RCT), interventions including VR, and assessment using a valid pain scale. Two reviewers independently assessed each study for methodological quality and came to consensus based on PEDro guidelines.

RESULTS: A total of 486 articles were screened for eligibility. After detailed screening, 6 RCTs fulfilled selection criteria. PEDro scores ranged from 5 to 10/10 (average, 6.7). Samples ranged from 21 to 52 subjects (207 total). Average age of subjects ranged from 24 to 68 years old. Five of 6 studies reported baseline average LBP ranging from 6 to 7 on a visual analog scale (VAS) (average, 6.56). Virtual reality intervention was performed for an average of 22.2 minutes per session (range, 8-30 minutes). Four of 6 studies reported 3 to 5 VR sessions (average, 3.5) per week for 2 to 8 weeks (average, 5.5). All 6 studies used noninvasive VR and reported significant within group differences in pain reduction for VR groups. Four of 6 studies also compared between group differences. Of these studies, 2 found statistically significant reductions in pain for groups receiving VR with conventional PT or VR alone, compared to conventional PT. Other clinically significant benefits of VR reported in the studies included: improved program adherence, well-being, motivation, and a decrease in fear avoidance behavior.

CONCLUSIONS: There is moderate to strong evidence to suggest that VR is an effective intervention for decreasing chronic LBP in adults when combined with conventional PT. There is limited evidence that VR alone, or in conjunction with conventional PT, is better than conventional PT alone for decreasing LBP. Limitations included variable treatment parameters and VR interventions, and a lack of between group comparisons in some studies. Future studies should examine pain reduction in VR only groups as compared to conventional PT groups.

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PURPOSE/HYPOTHESIS: Limited flexibility is often cited as one of the intrinsic reasons for sports injuries, postural deformities, and movement dysfunctions. Flexibility is an important component of any athletes’ regime. Manufacturers of vibration devices claim that their devices enhance circulation, flexibility, pain elimination, wound healing, and strength. They also claim that the application of local or focused vibration therapy produces both local and systemic effects on flexibility. The purpose of this study is to determine if changes occur in general flexibility, to the low back, hamstrings, or ankle flexibility after using a localized vibration device.

NUMBER OF SUBJECTS: There were 43 healthy subjects ranging in age from 21 to 40 years old.

MATERIALS/METHODS: They were randomized to either a STUDY or a CONTROL group. Their demographic characteristics did not differ by group. Lumbar flexion, hamstring, and triceps surae length changes were be compared at baseline and after each treatment session. Each treatment session consisted of three 2-minute vibration treatments to each of the areas being measured. Three total treatment sessions were delivered over a 6-day period. Changes in flexibility were compared within and between control and study groups. The MIXED procedure in SAS was chosen to fit linear models of each outcome because it can allow us to account for the repeated measures of flexibility over time without making assumptions about the correlation or covariance structure among those repeated measures.

RESULTS: Participants in the STUDY group demonstrated significant (P<.001) gains in all but 1 flexibility measurement immediately after the application of the localized vibration. There were no changes in flexibility between visits for the STUDY group and there were no change in ROM for the CONTROL group (within or between visits).

CONCLUSIONS: These results suggest that there are no long-term changes in flexibility of the lower extremity or spine due to vibration drum therapy. However, within visit between the pre and post measurements there are slight increase in clinically meaningful flexibility measurements of the lower extremity and spine for participants who underwent vibration drum therapy.

CLINICAL RELEVANCE: Vibration therapy is becoming popular especially among competitive athletes and the effects need further investigation to see if it enhances flexibility, which may or may not enhance performance and reduce injury. Few randomized controls exist and the preponderance of the literature has studied whole body vibration versus the local application of vibration. This is the first randomized controlled study to examine localized vibration and its effects on flexibility without placing the muscle in a stretched position.

GAIT ALTERATIONS IN FEMOROACETABULAR IMPINGEMENT SYNDROME DIFFER BY SEX

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PURPOSE/HYPOTHESIS: Femoroacetabular impingement syndrome (FAIS) is a clinical diagnosis given when hip pain is present along with structural morphology thought to contribute to premature contact between the proximal femur and acetabulum during movement. Previous studies have evaluated gait in individuals with FAIS, but have only reported on the involved limb and have not conducted sex-specific analyses. The purpose of this study was to evaluate sex-specific differences in gait in individuals with FAIS compared to individuals without FAIS.
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NUMBER OF SUBJECTS: Eleven males with FAIS (mean ± SD age, 25.3 ± 8.0 years; mass, 82 ± 9 kg; height, 1.80 ± 0.08 m) were group matched with 19 males without FAIS (age, 25.1 ± 6.2 years; mass, 77 ± 12 kg; height, 1.79 ± 0.07 m). Eight females with FAIS (age, 22.4 ± 6.6 years; mass, 61 ± 7 kg; height, 1.68 ± 0.07 m) were group matched with a group of 22 females without FAIS (age, 22.5 ± 2.8 years; mass, 60 ± 8 kg; height, 1.64 ± 0.07 m).

MATERIALS/METHODS: We recruited individuals with physician-diagnosed FAIS who had pain reproduced with provocative tests and individuals without FAIS (no lower extremity pain/injury and no pain during provocative tests). We recorded lower extremity kinematic data with a motion capture system while individuals walked at their preferred speed and at a prescribed speed (1.25 m/s) on a treadmill. Joint and segment angles were calculated using Visual3D. Peak hip and pelvic angles in the sagittal and frontal planes were identified. Separate linear regression analyses for males and females were used to examine the effects of group, side, and interaction of side by group. For the FAIS group, the involved side was the (more) painful side. For the control group, the involved side was randomly assigned.

RESULTS: When compared to sex-matched controls, males and females with FAIS had different gait alterations. In males, there were group differences, but no effect of side, indicating that differences were bilateral. Males with FAIS walked with 7° less peak hip extension, 5° less posterior pelvic tilt, and 5° more anterior pelvic tilt than males without FAIS at both walking speeds (P < .04). Males with FAIS also had 1.4° less hip abduction than males without FAIS (P < .04) at the prescribed walking speed. For females, significant interactions of group and side were noted for hip extension and adduction (P < .02). Females with FAIS walked with 2° less hip extension on the involved side compared to the less involved side (P < .03). Females with FAIS walked with 3° more hip adduction on the involved side than the less involved side at both walking speeds, a difference which was significant at the preferred speed (P = .01), but not the prescribed speed (P = .07).

CONCLUSIONS: Gait alterations in individuals with FAIS were sex-specific. Males with FAIS displayed a bilateral reduction in hip extension while females with FAIS displayed a unilateral reduction in hip extension and increase in hip adduction.

CLINICAL RELEVANCE: These gait differences may indicate different etiology of hip pain and the need for sex-specific movement interventions for individuals with FAIS.

OP0174

ARE PHYSICAL THERAPISTS’ LOW BACK PAIN BELIEFS DRIVING TREATMENT PATTERNS?
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PURPOSE/HYPOTHESIS: Low back pain (LBP) is a leading cause of health care utilization and work disability. Of all nonspecific LBP, about 90% will resolve within 6 weeks with little to no intervention; yet, 50% will seek care. Evidence-based (EB) LBP clinical practice guidelines (CPG) inform clinicians of optimal management. A knowledge-practice gap exist and clinicians’ beliefs are associated with poor CPG adherence. Clinician LBPB correlate with patient beliefs. CPG recommend addressing patients’ LBPB early to reduce risk of chronicity. However, clinicians with pain-focused beliefs may reinforce maladaptive patient beliefs. The relationship between physical therapists’ LBPB and practice has not been elucidated. The purpose of this 2-phase study was to (1) identify patterns of treatment recommendations relative to the CPG (concordant/discordant) (CPGC/CPGD) for standardized patient-cases of LBP among PT employed by an urban health care system (UHS) and (2) investigate if LBPB predict practice behaviors when treating patients with LBP. This abstract represents Phase 2.

NUMBER OF SUBJECTS: Sixty-nine PTs practicing in outpatient clinics throughout an UHS.

MATERIALS/METHODS: A cross-sectional study. Participation was anonymous and voluntary. An electronic survey including the Back Beliefs Questionnaire and 6 validated vignettes describing patients with acute, chronic or very chronic LBP, with/without yellow or red flags was emailed to all participants. Each vignette included a questionnaire to assess PT treatment preferences in the domains of diagnostics, activity recommendations, therapeutic procedures, medication, referrals and education. Two widely accepted CPG were used to score treatments as CPGC or CPGD. Chi-square tests and relative risks were calculated to assess the association between the risk of having a belief and recommending CPGC/CPGD treatment. Mann-Whitney was used for continuous data. Two-sided P values less than .05 were considered statistically significant.

RESULTS: Sixty-nine PT participated in the study (60% female) 78% with DPT education and 59% having fewer than 10 years of clinical experience. The practice behavior, “Sick leave is a good treatment for back pain” was positively correlated with maladaptive beliefs (CC>0.3, P<0.05) and negatively correlated with positive beliefs about pain (CC<-0.3, P<0.05). Two maladaptive beliefs predicted CPGD behaviors; “Pain intensity is related to the degree of injury” and “Pain reduction is a prerequisite for RTW” (RR=1, P<0.05). Conversely those with the belief “I advise patients with LBP to continue with activity even if it hurts” were less likely to recommend CPGD care (RR=1, P<0.05).

CONCLUSIONS: Significant correlations were found between PT LBPB and their practice behaviors. LBPB maladaptive beliefs predictive of CPGD practice patterns were reflected in excessive treatment, inappropriate referrals and a biomedical approach to care.

CLINICAL RELEVANCE: Maladaptive LBPB appear to drive practice behaviors and impede EB practice. Training programs should focus on belief modification as PT LBPB are determinants of clinical practice behaviors.

OP0175

LUMBAR REPOSITIONING ERROR INCREASED WITH A REPEATED SPINAL FLEXION TASK IN ASYMPTOMATIC INDIVIDUALS
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PURPOSE/HYPOTHESIS: It has been proposed that poor proprioception in the lumbar spine is a possible reason for developing low back pain. A method of this is through lumbar repositioning error (LRE). LRE is the distance between the start and end position of the lumbar spine after performance of a task. However, recent studies have not assessed LRE with high repetitions and a biomedical approach to care. Therefore the purpose of this study was to determine if LRE changes with a repetitive trunk flexion task in asymptomatic young individuals. If an increase in LRE is seen, an assumption for this could be due to fatigue. In this case, fatigue can be defined as the body’s inability to reposition itself to the original position, thus adopting an easier position to maintain for a longer duration.

NUMBER OF SUBJECTS: Fifty-nine asymptomatic young adults (mean ± SD age, 25.15 ± 2.38 years) completed the protocol approved by the IRB at the University of Illinois at Chicago.

MATERIALS/METHODS: Eligible subjects (younger than 35 years old, no thoracic, lumbar, or lower extremity pathology, or neurological condition) passed an initial screening process. LRE was assessed using video analysis (Dartfish 8.0). Subjects were seated and a visual tracker placed at L2 spinous process. Subjects assumed a comfortable resting posture and performed 55 trunk flexion repetitions at a self-selected pace. They were asked to return to their initial resting posture after each repetition. LRE has been previously represented as absolute error (AE), the absolute val-
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ue (cm) of the distance from start to stop position for each repetition. This study calculated AE for each subject over a series of 10 repetitions (1-10, 11-20, 21-30, 31-40, 41-50). The mean AE (MAE) of each series of 10 repetitions was then calculated (MAE1, MAE2, etc) for each subject.

RESULTS: An increase of MAE was identified over the 50 repetitions, comparing MAE1 (1.65 ± 1.04 cm), MAE2 (1.90 ± 1.20 cm), MAE3 (2.0 ± 1.31 cm), MAE4 (2.02 ± 1.27 cm), and MAE5 (2.18 ± 1.41 cm). Repeated-measures ANOVA revealed a statistically significant difference of MAE1 versus MAE2-5 (P<.05). No differences were seen between MAE2 and MAE5 (P>.05).

CONCLUSIONS: The results showed that asymptomatic individuals demonstrated a significant change in LRE within 20 repetitions of the flexion task. The difference in LRE between MAE1 and MAE2 indicate a time point when subjects were no longer able perform the desired repositioning task, which may suggest the onset of fatigue.

CLINICAL RELEVANCE: Assessment of repositioning error may require at least 20 repetitions to demonstrate the body's response to fatigue. Activities of daily living are repetitive tasks and will be more relevant to assess the lumbar spine under load or fatigue. It has been established that muscle performance is altered in the presence of pain or inhibition. As this study included asymptomatic young healthy adults, the results may encourage clinicians to not overlook high repetition tasks, as compensatory patterns may not be seen with fewer repetitions.

**OP0176**

GAIT SPEED AND TIMED UP-AND-GO SCORE ASSOCIATED WITH INCREASED FALL RISKS FOR TOTAL SHOULDER ARTHROPLASTY AND ROTATOR CUFF SURGERY

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PURPOSE/HYPOTHESIS: Falls pose a potentially serious risk for patients undergoing shoulder surgery in order to optimize outcomes and prevent any compromise to healing structures. Slower gait speed has been associated with higher fall risks and mobility deficits. It is important to evaluate patients undergoing surgery that may be at risks due to the likelihood of FOO SH injuries for postoperative concerns. No study has examined fall risk in a patients undergoing shoulder surgery. Given most patients undergoing rotator cuff repair and Total Shoulder arthroplasty, patients will be required to wear a sling that may influence their balance and fall recovery. The ability to understand fall risk is important to maintain functionality and improved outcomes. To evaluate and identify patients for fall risk that are scheduled to undergo rotator cuff repair and total shoulder arthroplasty.

NUMBER OF SUBJECTS: One hundred ninety-eight total patients scheduled for TSA and RTC surgery were evaluated preoperatively from multiple outpatient physical therapy clinics within Greenville, SC.

MATERIALS/METHODS: Primary outcomes which patients were problem solved and form filled out at time of testing. Baseline measurements show that Patient’s undergoing TSA (n = 80; mean ± SD age, 65.4 ± 11.4 years) surgery in older than those undergoing RTC surgery (n = 118; mean ± SD age, 59.0 ± 14.2 years). Fifty-nine percent of all patients were under the cut of score for gait speed (less than 0.7 m/s) for both groups. Sixty-two percent of TSA groups were found to be more at risk for falls based on cut off score (less than 14 seconds) compared to 37% for RTC group. No differences were found between groups for walking speed (TSA, 1.4 ± 2.1 m/s; RTC, 1.7 ± 3.0 m/s), SES (RTC, 46.4 ± 14.9; TSA, 43.5 ± 18.8), SANE (RTC, 37.2 ± 23.7; TSA, 33.7 ± 22.5), VR-12 MRS (RTC, 51.4 ± 10.4; TSA, 49.4 ± 13.6), VR-12 PCS (RTC, 34.4 ± 8.5; TSA, 34.5 ± 7.9).

CONCLUSIONS: This study suggests that patients undergoing TSA may be more likely to be at risk for falls based on fall scores and demographics. Additionally, gait speed alone may not be a predictor of fall risks or mobility deficits for this population.

CLINICAL RELEVANCE: Clinicians should consider performing The TUG and gait speed following TSA and RTC during their postoperative evaluation to identify patients who may be more at risk for falls and post surgical complications.

**OP0177**

THE EFFECTS OF DIFFERING BIOFEEDBACK METHODS ON EMG RATIO DURING SCAPULAR PLANE HUMERAL ELEVATION

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PURPOSE/HYPOTHESIS: The purpose of this study is to examine 3 specific types of feedback: continuous visual EMG biofeedback, binary auditory EMG biofeedback, and manual feedback, to determine the relative efficacy of each in the acquisition and retention of target muscle activation ratio during scapular plane humeral elevation. We hypothesize that the visual condition will produce a greater decrease in upper trap activation ratio than when compared to the auditory and manual conditions.

NUMBER OF SUBJECTS: Twenty-eight.

MATERIALS/METHODS: Custom Labview visual display of real-time surface EMG muscle ratio; 2-lb weight Subjects were randomized into 1 of the 3 groups: manual and verbal facilitation, binary auditory EMG biofeedback, or continuous visual EMG biofeedback. All groups performed 6 reps of scapular plane humeral elevation (3 reps to 90° and 3 reps to 135°, in a random order) during baseline testing, intervention, and posttest. Average UT:LT activation ratios were obtained for each arm angle during baseline testing. A subject's average was then used as the EMG ratio threshold during the intervention phase for the auditory and visual groups; subjects were instructed to keep their ratio below this threshold. Posttesting followed the same procedure as the baseline test. We then calculated the percent decrease in average EMG ratio from baseline to posttest. Posttest data were transformed into percent change from baseline and subjected to a 2-way between-subjects ANOVA: factors arm angle (2 levels) and intervention (3 levels).

RESULTS: A statistically significant effect was found for intervention; there was no main effect for arm angle and no interaction. A post hoc analysis revealed that the main effect for intervention was driven by a statistically significant difference between the visual condition and the auditory condition, with the visual condition showing a greater percent decrease in EMG ratio from baseline.

CONCLUSIONS: The use of a real-time, continuously updated visual representation of UT:LT EMG ratio (superimposed on the baseline EMG ratio average) produced a greater percent decrease in EMG ratio than an auditory tone which sounded when the subjects were maintaining a ratio below their baseline. The visual condition did not differ significantly from the manual condition; although this comparison did not rise to the level of statistical significance, there was a trend towards a greater effect in the visual condition. This study provides support to the hypothesis that a continuous visual method of EMG biofeedback is superior to a binary auditory EMG program.

CLINICAL RELEVANCE: A similar visual method of EMG biofeedback could be applied to take-home biofeedback units. In doing so, visual feedback provides patients real-time ability to assess success at achieving a prescribed muscle activation pattern. This type of unit would assist in the correct performance of home exercise programs and allow the patient to increase awareness of movement patterns. Further research is needed to determine dosage, retention periods, and adherence.
PO178
THE IMPORTANCE OF PHYSICAL THERAPY DURING THE HEALING PROCESS OF A TRIANGULAR FIBROCARTILAGE COMPLEX TEAR WITH SUSPECTED NONDISPLACED FRAC TURES OF TRIQUETRAL AND CAPITATE BONES
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BACKGROUND AND PURPOSE: Posttraumatic suspected nondisplaced fractures of the triquetral and capit rate bones with focal full thickness tear de fect through the radial and central aspect of the triangular fibrocartilage disc should be considered as a possible acute injury of hand/wrist. A physical therapist's ability to apply clinical reasoning is paramount to the clinical decision making process when treating complex patient cases.

CASE DESCRIPTION: A 37-year-old male coordinator tripped over a cable at work, fell forward to the floor and used his right wrist in an attempt to break his fall. Initial X-rays on the day of injury were negative for fracture or dislocation. Upon initial evaluation, pain was reported with palpation on the ulnar aspect of wrist and dorsum of right wrist crease. Moderate to severe pain reported during right wrist active and passive range of motion in all directions. Range of motion and strength deficits were present in flexion, extension, and ulnar deviation. Positive Special Tests: Press. Negative Special Tests: Tinel's. Patient's activity limitations were gripping, twisting, and upper extremity weight bearing activities.

OUTCOMES: After evaluation, patient presented with symptoms consistent with Triangular Fibrocartilage Complex (TFCC) sprain. Patient showed improvement in resting pain levels and function with each session of physical therapy. However, work-simulated functional activities involving weight bearing, twisting, and vibration resulted in high pain levels and ongoing symptoms which suggested the patient would benefit from additional imaging. The supervising physical therapist discussed the case with the medical doctor and recommended Magnetic Resonance Imaging (MRI) which was then ordered. The MRI showed suspected nondisplaced fractures of the triquetral and capit rate bones with focal full thickness tear defect through the radial and central aspect of the triangular fibrocartilage disc.

DISCUSSION: Despite having 2 suspected fractures and a TFCC tear, physical therapy x to 3 decreased pain and inflammation and improved non-weight-bearing wrist function. After physical therapy was discontinued, pain returned to an 8/10 in the wrist indicating patient may have regressed due to the interruption in physical therapy directed movements x to 3 to decrease pain and maintain function. Physical therapy was eventually resumed leading to a return to functional ability. Though casting was never implemented, the patient's wrist brace x was replaced and he maintained light duty. It is essential that physical therapists maintain optimal clinical reasoning and recognize when to alter the course of treatment to fit the patient's needs in order to ensure a return to full function.


PO179
PROGRESSIVE REHABILITATION AFTER TOTAL HIP ARTHROPLASTY: A PILOT AND FEASIBILITY STUDY
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PURPOSE/HYPOTHESIS: The incidence has increased and the median age has decreased for total hip arthroplasty (THA). Although surgical techniques and biomaterials have improved, rehabilitation has not kept pace with the needs of a changing demographic. The purpose of this study was to evaluate the feasibility and preliminary effectiveness of a progressive strengthening and functional retraining intervention after THA.

NUMBER OF SUBJECTS: Nineteen subjects completed this study; Control group (n = 9; age, 67 years; 55% male) experimental group (n = 10; age, 58 years; 70% male).

MATERIALS/METHODS: The experimental intervention was novel with respect to timing and content with fewer visits early after surgery. Training was tailored to individual patient goals incuding a progressive home exercise program while the control group received usual care with no constraint on timing. Testing included 3-D motion analysis and clinical evaluation before surgery and 16 weeks postsurgery. Peak vertical ground reaction force symmetry between limbs during sit to stand was calculated as operated/nonoperated. Quadriceps index (QI) was measured as the symmetry in isometric strength between limbs (operated/nonoperated). Repeated measure ANOVAs were performed for functional measures and biomechanical variables of interest. To assess surgical hip side pain a univariate logistic regression was used with preop pain as a covariate. Patient satisfaction and number of rehabilitation visits was compared using independent sample t tests. Safety and feasibility was assessed using descriptive analysis.

RESULTS: There was a significant interaction effect for the 5 Minute Walk (P = .02) with the intervention group walking a significantly greater distance at follow-up (386 m versus 461 m, P = .04), but groups improved over time (P<.01). There were significant interaction effects for the Hip Outcome Score (HOS) (P = .05) and Hip Disability and Osteoarthritis Outcome Score Jr (HOOS Jr) (P = .03), with the experimental group having significantly worse scores at baseline (HOS 53 versus 59; HOOS Jr -33 versus 45; P = .03), but groups improved over time (P<.01). There was an interaction effect for QI (P = .04); the intervention group had a significantly greater QI at follow-up (0.92 versus 0.77, P = .01) and significant improvement over time (P = .03). There was an interaction effect for sit to stand symmetry (P = .041) in which the intervention group became more symmetrical and the control group more asymmetrical. The intervention group had significantly greater satisfaction (96 versus 84 out of 100, P = .03) at the conclusion of the intervention. There were no adverse events and there was no difference in the number of visits between groups.

CONCLUSIONS: This novel treatment protocol is safe and feasible in a clinical setting with positive impact on function, biomechanics and satisfaction. The intervention group exhibited biomechanical improvements and greater gains in symmetry and 6MWT.

CLINICAL RELEVANCE: This novel therapy protocol may be more appropriate and provide better clinical outcomes than traditional rehabilitation given the changing patient demographics.

PO180
RELATIONSHIP BETWEEN STATIC AND DYNAMIC POSTURAL CONTROL IN INDIVIDUALS WITH AND WITHOUT CHRONIC ANKLE INSTABILITY
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PURPOSE/HYPOTHESIS: Lateral ankle sprains are common orthopaedic injuries that often result in chronic ankle instability (CAI). An individual with CAI has a history of at least 1 significant ankle sprain with feelings of “giving way,” and/or instability,” and/or recurrent sprains. Copers have also sustained 1 significant ankle sprain, but are able to return to their preinjury levels without any residual pain or symptoms. Previous studies have documented postural control deficits in CAI. However, there is little re-
search comparing static balance on tilt platforms to more clinically relevant dynamic balance, or limits-of-stability tests. Our goal was to assess the relationship between static and dynamic postural control in assessing deficits in individuals with chronic ankle instability.

**NUMBER OF SUBJECTS:** Unilateral CAI (n = 18; mean ± SD age, 22.4 ± 2.8 years; IdFAI, 21.3 ± 8.3), Unilateral Copers (n = 15; age, 22.4 ± 3.2 years; IdFAI, 7.3 ± 2.5), and healthy controls (n = 18; age, 22.2 ± 3 years; IdFAI, 2.9 ± 3.1).

**MATERIALS/METHODS:** The athlete single-leg test (ASL) and the Y Balance Test (YBT) were used to assess static and dynamic postural control respectively. The ASL was done on the Biodex Balance System SD. All participants completed 3 trials (1 practice and 2 recorded) without visual feedback at Levels 4 (the least stable), 8, 12, and static. Sway area was calculated using custom Matlab script. For the YBT, participants performed 3 practice trials for each leg in each of the 3 directions: Anterior (ANT), posterior medial (PM), and posterior lateral (PL). Maximum reach values of 3 trials for each direction were recorded and used to calculate a composite score. Correlation tests were performed between sway area and YBT scores for each of the 3 groups.

**RESULTS:** The YBT composite score did not correlate strongly with sway area for any of the groups at any of the 4 levels. In the CAI population there was a moderate negative correlation at level 4 (the least stable) between sway area and ANT maximum reach (r = -0.527, P = 0.025). For Copers, there was a significant moderate negative correlation at the static level between sway area both FM maximum reach (r = -0.561, P = 0.029) and PL maximum reach (r = -0.589, P = 0.021).

**CONCLUSIONS:** Individuals with CAI who had difficulty maintaining postural control while pushing the block forward on YBT also swayed more while standing on a single leg on a very unstable platform. This could be due to a previously documented decreased dorsiflexion range of motion in individuals with CAI. Copers showed altered motor control strategies.

**CLINICAL RELEVANCE:** The current study provides evidence for clinicians to use an instrumented assessment of static postural control and noninstrumented assessment of dynamic postural control in individuals with CAI. While these tests may be useful in assessing, training and monitoring change in the CAI population, results from the current study indicate that the tests measure different aspects of postural control in individuals with CAI and Copers and cannot be used interchangeably.

**OP0181**

**INTERRATER RELIABILITY OF PHYSICAL THERAPY STUDENTS USING THE FUNCTIONAL MOVEMENT SCREEN**

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**PURPOSE/HYPOTHESIS:** Determine the interrater reliability when physical therapy students administered the Functional Movement Screen (FMS) test to firefighter recruits. It was hypothesized that there would be substantial agreement between raters for each FMS test item and there would be good interrater reliability for the FMS total score.

**NUMBER OF SUBJECTS:** Second year physical therapy students (n = 4) administered the FMS in groups of 2 to the firefighter recruits. All firefighter recruits (n = 30) enrolled in a local fire academy completed the FMS.

**MATERIALS/METHODS:** This study was a retrospective analysis of screening data from a local fire academy. Two groups of second year physical therapy students (Group 1: Raters 1 and 2; Group 2: Raters 3 and 4) administered the FMS to the fire recruits at the beginning and end of the fire academy. Student raters were trained to administer the FMS prior to the fire academy. Data analysis included descriptive statistics for firefighter recruits’ demographic data and FMS scores. Observed agreement and kappa values were calculated as a measure of agreement for each FMS test item. An intraclass correlation coefficient (ICC) was calculated as a measure of interrater reliability for the FMS total score.

**RESULTS:** The FMS test item final scores for group 1 showed a range of observed agreement between 73.3% to 100%, with kappa values indicating moderate to perfect agreement (κ = 0.44-1.00). Group 1 demonstrated perfect agreement on scoring 8 of the 17 FMS test items. Group 1 demonstrated good interrater reliability for the FMS total scores (Preacademy ICC = 0.858; Postacademy ICC = 0.976). The FMS test item final scores for group 2 showed that their range of observed agreement was between 80.0% to 100%, with kappa values indicating substantial to perfect agreement (κ = 0.66-1.00). Group 2 demonstrated perfect agreement on 7 of the 17 FMS test items. Group 2 demonstrated moderate to good interrater reliability for the FMS total scores (Preacademy ICC = 0.994; Postacademy ICC = 0.658).

**CONCLUSIONS:** Overall, there was moderate to good interrater reliability when physical therapy students determined the FMS total score for firefighter recruits. Physical therapy students demonstrated moderate-to-perfect agreement for the FMS test item final scores. The shoulder mobility and ASLR tests had the strongest level of agreement which was attributed to a more objective scoring method. Other test movements that demonstrated less agreement, such as the in-line lunge and hurdle step tests, required the rater to make a judgement about the quality of movement occurring in multiple planes.

**CLINICAL RELEVANCE:** The FMS is easily implemented as a screening tool for firefighter recruits because it takes a minimal amount of time to administer and is relatively easy to score. The interrater reliability for physical therapy students administering the FMS demonstrates that novice raters can administer the FMS.
The results of this study suggest that Physical Therapists should be aware of the high prevalence of pain, especially in the cervical spine and shoulder region, when working with patients who play console video games. A physical therapist should consider prolonged video game use as a potential contributing factor to the pain they are seeking treatment for. In addition, the position the individual chooses to play console video games in and the amount of time playing the games should be addressed.

OP0184

A MECHANISM FOR LIGAMENTUM TERES INJURIES IN FEMOROACETABULAR IMPINGEMENT: AN ANATOMICAL STUDY

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PURPOSE/HYPOTHESIS: Ligamentum teres (LT) injuries are commonly seen in hip arthroscopy and associated with the bony deformities of dysplasia and femoroacetabular impingement (FAI). As a rotational stabilizer of the hip, the potential mechanism behind LT tears and the instability occurring with dysplasia has been defined. However, the mechanism behind LT tears occurring with the over coverage of FAI needs to be described. Studies that included athletes with FAI reported some of the highest incidence of LT pathology, including 1 study that noted 93% of professional hockey players undergoing hip arthroscopy for FAI had LT pathology. The purpose of this study was to describe the mechanism behind LT tears and FAI.

NUMBER OF SUBJECTS: Twenty-six hips from 15 embalmed cadavers (8 male, 7 female) with a lifespan ranging between 55 and 93 years.

MATERIALS/METHODS: Each specimen was skeletonized and the hip vented to allow full range of motion (ROM) and visualization of the LT. The hip was placed in 90° of flexion and 0° of abduction/adduction. The hip was then internally rotated (IR) until the femoral head neck junction came into contact with the acetabulum. This position of impingement with respect to IR was recorded with a goniometer. The hip was then further internally rotated until end ROM was achieved and again the position of IR recorded with a goniometer. A paired t test was performed to assess for a difference in IR between the positions of impingement and end ROM.

RESULTS: The positions of IR when impingement occurred (mean ± SD, 9° ± 4.2°; range, –2° to 15°) when compared to end range (mean ± SD, 21° ± 5.7°; range, 5° to 27°) were significantly different (P = .005, t = 14.8). In all of the hips, after impingement occurred the site of boney contact between the femoral neck and acetabulum acted as a pivot point, with the femoral head being levered inferiorly and a loss of the rotational center within the acetabulum, as IR ROM continued. This movement of the femoral head caused the LT to tighten until the LT restricted further movement. Movement into IR beyond this end position caused rupturing of the LT.

CONCLUSIONS: IR ROM can occur beyond the position of impingement and resulted in abnormal inferior movement of the femoral head and tightening of the LT. End ROM of hip IR at 90° of flexion and 0° of abduction/adduction was limited by the LT.

CLINICAL RELEVANCE: This study provides cadaveric evidence for the mechanism of LT injury in FAI. This is of importance in those with FAI who engage in activities that required motion beyond the point of impingement, such as in athletics and in particular hockey.

OP0185

MEASUREMENT PROPERTIES OF THE SHOULDER PAIN AND DISABILITY INDEX: A SYSTEMATIC REVIEW

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PURPOSE/HYPOTHESIS: The Shoulder Pain and Disability Index (SPADI) is used extensively to obtain patient report of shoulder pain and disability in the presence of a pathology involving the shoulder joint. The SPADI is a reliable, valid, and responsive measure for assessing pain and function in
shoulder pathologies. Nonetheless, a systematic review that pools the results for these measurement properties of the SPADI across the published literature is nonexistent. This study located and appraised primary studies that examined the measurement properties of the SPADI across different shoulder pathologies.

**NUMBER OF SUBJECTS:** Not applicable.

**MATERIALS/METHODS:** Four databases (PubMed, CINAHL, AMED, conference papers) were searched between February 11-16, 2016 (search revised on June 1, 2017) to locate the peer-reviewed literature on the measurement properties of the SPADI. The studies published in English that assessed at least 1 measurement property of the English or other language versions of the SPADI were included in this review. A 12-item standardized checklist was used for assessing the quality of the studies included in the review. The indices of the test-retest reliability (intraclass correlation coefficient [ICC]), responsiveness (standardized response means SRMs), and minimal important change (MIC) were extracted from the studies included in the review.

**RESULTS:** A total of 38 primary studies were included in the review. The weighted kappa between the raters in appraising the quality of the included studies was 0.81 (0.75 0.88). The quality of the studies ranged from 58% to 92%, with 30 studies achieving greater than 70% quality rating indicating good quality. The ICC values ranged between 0.70 and 0.94 for the pain index (PI) and 0.84 and 0.96 for the disability index (DI) for a short retest period (1-7 days) indicating excellent reliability. The PI and DI showed good concordance (r>0.7) with other measures assessing same constructs of shoulder pain and disability respectively. The SRM ranged from 0.4 to 1.62 in patients with nonsurgical shoulder pathology to 1.13 to 8.9 in patients with surgically treated shoulder pathology indicating excellent responsiveness. The MIC for the total index score was 15 and 20 points respectively in patients diagnosed with nonspecific shoulder pain and rotator cuff disease.

**CONCLUSIONS:** The results of this study provide support to the measurement properties of the SPADI in assessing impairment in patients with shoulder pathologies. The review found that there is very minimal evidence on what should be considered MIC for the PI and DI, thus making it difficult for clinicians to infer patient-relevant change in pain or function using the SPADI.

**CLINICAL RELEVANCE:** The SPADI is a joint-specific measure which has high clinical utility in assessing impairment in patients with shoulder pathologies. This study provides a broad summary of the measurement properties of the SPADI and outlines the statistics that will help physical therapists in formulating measurable treatment goals using SPADI.

**OP0186**

**FUNCTIONAL REHABILITATION OF A PERSON WITH TRANSCERVICAL AMPUTATION THROUGH GUIDED MOTOR IMAGERY: A CASE STUDY**

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**BACKGROUND AND PURPOSE:** Motor imagery (MI) is a mental technique absent of physical movement employed to foster movement patterns and relieve pain via a top-down model enacting the brain before engaging the body. This method has been helpful in rehabilitating many functional limitations, such as those found in persons with stroke, Parkinson’s disease, and orthopaedic injuries. The current case study assessed MI’s efficacy in decreasing phantom limb pain and attaining functional gait and balance with a prosthesis after a lower extremity amputation.

**CASE DESCRIPTION:** The participant was a 71-year-old woman with a transtibial amputation occurring 7 years prior to the study due to peripheral arterial disease. She required a standard walker to walk with a prosthesis despite receiving physical therapy in the past. She lived independent but reported mobility limitations of phantom pain, arthritis, and a fear of falling. During this ABA design case study, the participant underwent baseline testing (PRE), followed by 3 sessions per week for 4 weeks of MI intervention, with an immediate posttest (POST) and 1-week postintervention retention (RET) test. Intervention sessions involved quiet sitting with eyes closed while listening to the experimenter read a MI script focusing on gait and balance performance. Progress was assessed via the Timed Up and Go (TUG), Short-Form Berg Balance Scale (Berg), Tinetti Performance Oriented Mobility Assessment (POMA), Activities-Specific Balance Confidence scale (ABC), and Short Form-12 (SF-12) survey. The 2-SD band method was used to determine significant changes.

**OUTCOMES:** TUG improved from PRE (29.5 ± 4.8 seconds) to POST (26.5 seconds) and RET (22.5 seconds). Berg improved significantly from PRE (177/56 ± 4.7) to POST (26/56) and RET (26/56). POMA improved significantly from PRE (15.3/28 ± 2.9) to POST (22/28) and RET (22/28). ABC improved significantly from PRE (44% ± 0.7%) to POST (45%) and RET (45.6%). SF-12 Physical Component Scale improved from PRE (41.5 ± 5.3) to POST (42.4) and RET (43). SF-12 Mental Component Scale improved from PRE (46.9 ± 7.7) to POST (50.9) and RET (50.2). Post-intervention, the participant reported decreased phantom pain frequency and duration, and walked with her prosthesis without an assistive device.

**DISCUSSION:** MI is a simple, time- and cost-effective, low-risk treatment option that decreased phantom pain and improved balance and functional gait in an individual with a lower extremity amputation and prosthesis. Though the participant’s results did not deem her low fall risk, her Berg, POMA, and ABC scores showed significant, retainable improvement that allowed her to walk a short distance independently for the first time in 7 years. This individual may benefit from a longer duration of MI training to further decrease fall risk. Use of MI as a stand-alone and/or adjunct treatment with physical therapy for amputation rehabilitation must be further examined.

iotherapists who can perform medical acts under delegation (ESP) have emerged as key providers in such new roles, especially regarding the treatment of patients with musculoskeletal disorders (MSKD). Many of these models have been implemented in emergency departments (ED) for the evaluation and treatment of patients with MSKD and recently greater implementation has been observed in many countries. An update of the available evidence is therefore warranted. Therefore, the objective of this study was to systematically review the current evidence regarding physiotherapists and ESP working in ED for care of patients with MSKD.

**PURPOSE/HYPOTHESIS:** A total of 21 studies were included.

**MATERIALS/METHODS:** Systematic literature searches were conducted in 5 bibliographical databases for articles published up until March 2017. Eligible studies needed to present quantitative data that assessed any outcome related to physiotherapy or ESP care for patients with MSKD in ED. Data extraction was performed and a pair of raters used the Crowe Critical Appraisal Tool to evaluate the quality of the studies. A qualitative synthesis of the evidence was performed.

**RESULTS:** Methodological quality of these studies varied from 35% to 93%. Two studies of moderate to high quality demonstrated that ESP care was as, or more, effective than usual care in terms of pain reduction and 6 out of 7 studies of moderate to high quality reported that ESP was as effective as usual care in reducing disability for patients with MSKD. Four studies of moderate to high quality concluded that adverse events were low and were similar between both types of care. Regarding use of health care resources, 5 studies with a low to high quality reported that ESP did not order more medical imagery than physicians. Eight studies of various methodological quality reported that ESP care can reduce wait time in the ED. In terms of health care costs, 2 studies with a moderate to high quality found no significant differences for direct and indirect costs between ESP and usual care. Finally, 6 studies with a moderate to high quality reported that patients were as satisfied or more satisfied with ESP care than with usual care.

**CONCLUSIONS:** The current literature suggests that physiotherapy and ESP care in the ED for patients with MSKD is at least as effective and as safe as usual medical care while improving access to care. Medical costs do not appear to be different with ESP care. There is a need for higher methodological quality studies to better assess the potential benefits of ESP care in ED.

**CLINICAL RELEVANCE:** The current data suggest that physiotherapy and ESP care in ED could represent a viable option to improve care for patients with MSKD. More systematic reporting of implementation projects for this type of care is warranted.

**OP018**

**PRELIMINARY RESULTS OF AN ADVANCED PRACTICE PHYSICAL THERAPY MODEL OF CARE FOR PATIENTS WITH MUSCULOSKELETAL DISORDERS PRESENTING TO AN EMERGENCY DEPARTMENT**

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**PURPOSE/HYPOTHESIS:** Physiotherapists have extensive training to treat patients with musculoskeletal disorders (MSKD) and are emerging as key providers in models of care aimed at improving the quality and access to care for this population. Often referred as advanced practice physiotherapy (APP), some of these initiatives have been implemented in emergency departments (ED), but there is limited evidence on the benefits of these models. The aim of this study is to assess pilot implementation of APP care in an ED. The specific objectives are to determine: (1) the diagnostic interrater reliability between physicians and APPs and (2) to compare between providers requests for additional medical imaging, proposed treatment options as well as discharge plans.

**NUMBER OF SUBJECTS:** Thirty-one patients presenting to the ED at the Maisonneuve-Rosemont Hospital in Montreal, Canada and suffering from an MSKD disorders were recruited.

**MATERIALS/METHODS:** Demographic and clinical characteristics of the participants were collected. All participants were independently assessed by an ED physician (n = 9) and a physiotherapist (n = 2). Each provider completed a standardized form indicating primary diagnosis, request for additional imaging and proposed treatment options. Descriptive statistics were used to present the participants’ characteristics. To compare interrater reliability Cohen’s kappas and PABAKs, with associated 95% CI, were calculated.

**RESULTS:** The mean ± SD age of participants was 51 ± 15.4 years (16 women and 15 men). Twelve participants presented with a traumatic injury. There was a substantial diagnostic agreement between physicians and APPs (Raw agreement RA, 74%; k = 0.79; 95% CI: 0.61, 0.96). Medical imagery request agreement between ED physicians and APPs was fair (RA, 68%; PABAK = 0.36; 95% CI: –0.03, 0.67), with physicians ordering more imagery. There was an almost perfect agreement between the providers regarding the need for medical follow-up upon ED discharge (RA, 91%; PABAK = 0.81; CI: 0.39, 0.97). Regarding prescription drugs recommendation, fair agreement was observed (RA, 0.61; PABAK = 0.21; CI: –0.19, 0.57), with physicians recommending more medication than APPs. Regarding referral to physiotherapy care upon ED discharge, there was slight agreement between providers (RA, 0.54; PABAK = 0.07; CI: –0.32, 0.45), with APPs recommending more physiotherapy care then physicians.

**CONCLUSIONS:** Preliminary results show that there is a substantial diagnostic agreement between providers. APPs tend to prescribe less imaging tests. Regarding the discharge plan, APPs resort more to physiotherapy care in their plan, but physicians and APPs tend to agree on the indication for medical follow-up.

**CLINICAL RELEVANCE:** Evidence-based development of APP models has the potential to profoundly impact care for patients with MSKD and is a novel model that may alleviate increasing health care demands. Further evaluation of such models is warranted.

**OP019**

**THE IMPACT OF BODY WEIGHT, AGE, AND TOBACCO AND ALCOHOL USE ON PRESENCE OF SECONDARY MUSCULOSKELETAL CONDITIONS IN SERVICE MEMBERS WITH UNILATERAL AMPUTATIONS**

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**PURPOSE/HYPOTHESIS:** Recent engagement in combat has resulted in over 1645 major limb amputations. Risk factors for development of secondary conditions have not been well studied. The purpose of this study was to investigate the association between common risk factors, such as body weight, age, tobacco and alcohol use, and presence of secondary musculoskeletal injuries.

**NUMBER OF SUBJECTS:** This study included service members with unilateral transfemoral (n = 237) and unilateral transfemoral (n = 321) combat-related amputations (mean ± SD age, 25.7 ± 5.3 years; 98.8% male).

**MATERIALS/METHODS:** Weight, age, self-reported tobacco and alcohol use were extracted retrospectively from electronic medical records after lower limb amputation. Musculoskeletal conditions, identified by International Classification of Diseases, 9th Revision codes, were retrieved from the Military Health System Medical Data Repository and grouped by body
Neuromuscular response to perturbation was obtained after participants completed perturbations under 4 conditions. An anticipated perturbation and an unanticipated perturbation, both applied with and without a preload mass. For each perturbation, the SCM onset latency, average post-drop Electromyography (EMG) activity, and time to peak EMG activity were calculated. A Pearson-Product Correlation coefficient (r) was used to examine the relationships among cervical musculoskeletal characteristics and to neuromuscular response of perturbations.

RESULTS: Nine out of 10 relationships among cervical musculoskeletal characteristics were statistically significant (r = 0.32-0.96, P<.04). Outside the likely spurious relationship between neck circumference and time-to-peak EMG amplitude of 1 trial type (r = −0.48, P=.036), cervical musculoskeletal characteristics were not related to muscle onset latency (r = −0.29 to 0.05, P>.17), average EMG amplitude (r = −0.29 to 0.44, P>.08) or time to peak EMG (r = −0.38 to 0.19, P>.067).

CONCLUSIONS: The results of this study indicates that neck circumference, SCM size, MVIC, RFDMax and RFDpulses measure related, but not identical aspects of cervical musculoskeletal function. The results also suggest that cervical musculoskeletal characteristics neuromuscular response to perturbation represent unique (ie, divergent) constructs.

CLINICAL RELEVANCE: Training aimed to induce muscle hypertrophy and increase strength may not yield changes to neuromuscular response to impulsive loads. Effective training to mitigate impulsive loads must include neuromuscular training to modulate the neuromuscular response to impulsive loads.

OP0191


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BACKGROUND AND PURPOSE: Chronic tendinopathy of the long head of the biceps (LHBT) is a common condition which is difficult to treat. Shoulder pain related to long head of the biceps tendon (LHBT) pathology due to inflammation can be debilitating and may interfere with an individual’s activity and participation due to consistent complaints of pain. There is a paucity of literature reporting the effects of manual therapy and exercise for rehabilitation of patients with chronic tendinopathy of LHBT.

Eccentric exercise (EE) has been shown to be an effective treatment for certain tendinopathies. Additionally, dry needling (DN) has been advocated as an intervention for tendinopathy, purported to induce bleeding and a localized healing response. However, the effect of these combined interventions on bicipital tendinopathy (BT) is in unknown. The purpose of this case series is to describe the outcomes of 10 patients with chronic BT treated with EE and DN.

CASE DESCRIPTION: All 10 patients (mean ± SD age, 40 ± 13 years; range, 24-64 years; 8 male, 2 female) reported chronic anterior shoulder symptoms greater than 3 months, pain with palpation of the LHBT, and positive results on Speed’s, Hawkins Kennedy, Neer and Yergason’s tests. Of the 10 patients, 8 had a history of prior physical therapy treatment. The mean Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) score at initial examination was 33.61%. The mean numeric pain-rating scale (NPRS) score at initial examination was 6.1. Each patient was treated with 2 to 8 sessions of DN into the most painful and/or thickened areas of the tendon, confirmed with palpation. An EE program and stretching of the biceps muscle/tendon followed each DN session and patients were asked to perform the program daily for the course of treatment. At discharge patients completed a global rating of change (GRC), a QuickDASH and NPRS.

OP0190

IS CERVICAL NEUROMUSCULAR RESPONSE TO HEAD-NECK PERTURBATION RELATED TO CERVICAL MUSCULOSKELETAL CHARACTERISTICS?

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PURPOSE/HYPOTHESIS: Although recent studies investigated the role of the cervical spine in response to impulsive loads, the majority of studies remained focused on cervical musculoskeletal characteristics such as neck circumference, muscle size, isometric strength, and rate of force development. However, it is unclear if musculoskeletal characteristics are related to neuromuscular response after head-neck-evoked perturbation. The purpose of this study is to examine the relationship among musculoskeletal characteristics and neuromuscular response after evoked head-neck perturbation. We hypothesize that cervical musculoskeletal characteristics are related to each other, but are not related to neuromuscular response to perturbation.

NUMBER OF SUBJECTS: Nineteen recreationally active participants, 9 male and 10 female.

MATERIALS/METHODS: Five musculoskeletal measurements were obtained. Neck circumference was measured using a cloth tape, and the Sternocleidomastoid (SCM) size quantified using a diagnostic ultrasound imaging machine. The maximum volumetric isometric contraction (MVIC) for neck flexion and rate of force development (RFDMax) were also found. Furthermore, submaximal RFD was recorded from a series of rapid volitional pulses of isometric neck flexion (RFDpulses).

RESULTS: Average maximum weight postinjury was 206.9 ± 36.1 lb. Out of this sample, 96.5% reported tobacco use and 97.1% reported drinking after injury. Tobacco and alcohol use were not associated with musculoskeletal conditions regardless of body region (P>.05). However, a 5-lb increase in body weight was associated with 5% increased odds of presence of least 1 musculoskeletal condition (odds ratio [OR] = 1.05; 95% confidence interval [CI] = 1.01, 1.08; P<.05) as well as lower extremity musculoskeletal condition (OR = 1.05; 95% CI: 1.02, 1.07; P<.05). Increasing age was also found to be associated with presence of both lower extremity and lumbar spine musculoskeletal conditions (OR = 1.09; 95% CI: 1.06, 1.13; P<.001; OR = 1.05; 95% CI: 1.01, 1.08; P<.01, respectively).

CONCLUSIONS: Increased weight after amputations may put an individual at increased odds of presenting with a musculoskeletal condition. This may be due to increased load on the joints leading to complaints of pain and early degenerative changes. Increasing age is a known risk factor for low back pain, demonstrating this sample’s similarity to the general population. Although no associations were found with tobacco and alcohol habits, the majority of the sample reported to engage in this behavior. Further analyses taking into consideration frequency and magnitude of smoking and alcohol use (ie, light versus heavy drinker) may reveal associations.

CLINICAL RELEVANCE: Lifestyle habits can be addressed by a variety of health care professionals, including physical therapists. Of particular consideration, service members with amputations tend to be at a young age emphasizing the importance of lifelong health. Patient education on healthy habits such as weight management, smoking cessation and limited alcohol drinking may prevent associations.
OUTCOMES: At discharge, the patients had an improved mean QuickDASH of 77.5% ± 10.8%, NPRS of 2.2 ± 1.3, GRC of -5.4 on a 15-point scale (-7 to +7) with 5 points being defined as important improvement. Findings from this retrospective case series suggest that EE and DN in combination may be beneficial in patients with chronic LHB tendinopathy contributing to symptomatic and functional improvement.

DISCUSSION: The results of this case series suggest that DN and EE may be a beneficial treatment for the management of BT. Further research on the efficacy of this novel treatment approach is warranted. If DN and EE show to effectively reduce symptoms of chronic BT in controlled trials and this treatment approach becomes more widely adopted by physiotherapists, the clinical implications may include the avoidance of more invasive treatment techniques including surgery.


IMPLEMENTATION OF A PAIN SYMPTOM CLASSIFICATION ALGORITHM TO FACILITATE THE DEVELOPMENT OF DIAGNOSTIC REASONING STRATEGIES IN PHYSICAL THERAPY STUDENTS AND ORTHOPAEDIC PHYSICAL THERAPY RESIDENTS

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ABSTRACT BODY: Diagnostic reasoning has been identified as the process used to gain an understanding of a patient’s presenting condition, determine the underlying cause, and recognition of the impact of the condition on the patient’s ability to function in daily life. In this process of thinking, the PT uses information gathered during the examination to formulate a physical therapy diagnosis. Determining a physical therapy diagnosis involves identifying movement related dysfunction, should guide treatment selection, and is specific to the patient. The development of diagnostic reasoning is a complex process involving both deductive and inductive thinking. The development of diagnostic reasoning requires significant practice, and benefits from modeling of the thinking process by a mentor. Classification tools have been proposed to facilitate the diagnostic reasoning process, using a framework that assists in pattern recognition, and provides guiding principles that direct intervention selection. The symptom classification algorithm has been adopted from current musculoskeletal clinical practice guidelines as well as pain science literature, and is structured into 4 steps.

The first step is to identify the primary body region or source of the pain symptom (example: neck pain, shoulder pain, back pain) and determination of symptom duration (acute, subacute, chronic). The second step is to identify the primary impairment contributing to the presenting condition (example: mobility deficit, motor coordination deficit, muscle power deficit, radicular/referred pain, widespread pain, cognitive/affective tendencies). The third step is to identify the pain state (nociceptive pain, neuropathic pain, central sensitization). The final step is to consider the pain mechanism (input pain mechanism, processing dysfunction, output mechanism). After completion of the outlined decision tree, the physical therapy student/resident has identified a physical therapy diagnosis and a probable cause of the patient’s condition. Determining the patient’s primary impairment, pain state, and pain mechanism directly guides treatment selection and the development of a primary treatment strategy. The symptom classification algorithm provides a framework to guide the process of thinking and decision making during patient evaluation. Utilizing the symptom classification tool can assist in the collecting meaningful data during the examination, aid in the formulation of a physical therapy diagnosis, and then guides the choice of evidence based treatment intervention.

EVIDENCE-BASED PROCEDURES FOR PERFORMING THE SINGLE-LEG SQUAT TEST AND STEP-DOWN TEST: A SYSTEMATIC REVIEW

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PURPOSE/HYPOTHESIS: The purpose of this study was to systematically review the literature to identify the psychometric evidence to support the use of and the best methods for administration of the single-leg squat test (SLST) and step-down test (SDT). The results of this study will allow for a standardized protocol for administering the SLST and SDT in future research studies.

NUMBER OF SUBJECTS: Fifty-six current peer-reviewed research articles.

MATERIALS/METHODS: A search of the PubMed and SPORTDiscus databases were performed to identify psychometric evidence of reliability, validity, and responsiveness to support the use of the SLST and SDT. The best procedures used to collect this evidence was extracted, summarized, and combined to allow for creating the best procedure in administration of the SLST and SDT for individuals with trunk and lower extremity function.

RESULTS: Of the 3406 articles that were reviewed, 56 total articles met the predetermined inclusion criteria and were included in the review. The SLST and SDT showed a range of evidence test test-retest, intratester, and intertester reliability (ICC = 0.48-1.0, κ = 0.38-0.88) and (ICC = 0.38-0.98, κ = 0.13-0.67), respectively. Evidence of validity for the SLST found test performance to be influenced by the hip abductors, hip external rotators, hip extensors, and core musculature. Evidence of validity for the SDT found test performance to show that the gluteus medius, and medial and lateral hamstrings all had high muscle activity. Both functional tests have shown an increase in hip abductor strength and degree of knee flexion to have a significant effect on decreasing hip adduction and knee valgus. From these articles the best methods for administering the SLST and SDT were developed.

CONCLUSIONS: Evidence was available to support the use of methods to administer the SLST and SDT. Both tests are utilized to assess biomechanical stresses in the hip and surrounding muscular structures. These tests are indicative of the weight-bearing demands and dynamic muscular control needed for sports related movements. The overall movement pattern during descent for both tests include hip and knee flexion with anterior pelvic tilt, flexion at the trunk, and hip adduction with knee internal rotation and abduction. This pattern enables the clinician to evaluate all motions that can be limited, causing an increase in hip pain and dysfunction.
CLINICAL RELEVANCE: The SLST and SDT are commonly performed functional tasks in the clinical setting. Their use in this evaluation of patients with hip dysfunction has not been defined in the literature. This review establishes a standardized protocol for use in evaluation of patients with non-articular hip dysfunction including femoracetabular impingement and hip chondroplasty.

OP0194
RELIABILITY OF A 10-ITEM SHOULDER STRENGTH-TESTING PROTOCOL USING A HANDHELD DYNAMOMETER
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PURPOSE/HYPOTHESIS: Manual muscle testing (MMT) is widely used in physical therapy (PT) clinics; however, MMT does not objectively evaluate strength grades greater than 3/5. HandHeld dynamometry (HHD) provides objective, quantitative strength measurements that are more specific and sensitive to change than MMT grades, and thus better outcome measures. However, widespread use of HHD by physical therapists has been hampered by lack of standardization and reports of inconsistent reliability. The purpose of this study was to establish the intrarater reliability of an experienced tester in administering a standardized HHD shoulder strength protocol. This protocol has been used clinically for many years but was never tested for reliability. We hypothesized that the expert tester would be reliable using this protocol to measure strength.

NUMBER OF SUBJECTS: Twenty-five healthy subjects (mean ± SD age, 24.7 ± 3.5 years) with no current or recent shoulder pathology.

MATERIALS/METHODS: An orthopaedic physical therapy specialist administered a standardized strength-testing HHD protocol to 25 subjects. The protocol consisted of 10 unique maximal isometric break tests performed on each subject’s dominant upper extremity using a Lafayette HHD, capturing the peak force obtained during a 3-second strength test. Every recorded measurement was a subject’s 1-repetition maximum. If either therapist or subject felt that maximum force was not achieved, the test item was repeated. Subjects completed 2 full trials, 1 hour apart. Each trial consisted of 10 strength tests lasting 8 to 10 minutes. Data analysis was completed on SPSS using a 2-way mixed ICC to assess the intrarater reliability between the 2 trials.

RESULTS: The average ICC for the HHD shoulder protocol was 0.912, indicating excellent intrarater reliability. Each individual test was also considered excellent (ICC>0.891) except shoulder abduction at 90° (ICC = 0.738), rated good. For all measurements, P was less than .0005. Results demonstrated that the tester achieved predominantly excellent reliability administering the 10-item HHD shoulder strength protocol.

CONCLUSIONS: Results demonstrate that the tester achieved predominantly excellent reliability in administering 2 trials of a standardized 10-item HHD shoulder strength protocol on 25 subjects.

CLINICAL RELEVANCE: The physical therapy literature has questioned the ability between the 2 trials.


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PURPOSE/HYPOTHESIS: Low back pain (LBP) is the most common complaint among patients presenting to outpatient physical therapy (PT) settings. Medical screening is an essential component of LBP management. Diagnostic triage is a medical screening process through which patients are determined to be appropriate for PT management, or require medical consultation/referral. The purpose of this study was to determine the accuracy of diagnostic triage decisions rendered by physical therapists in low back pain management.

NUMBER OF SUBJECTS: Participants included a convenience sample of students from a graduate PT academic program, and a geographically representative sample of licensed physical therapists (PTs) in the United States. MATERIALS/METHODS: A Qualtrics survey was developed and distributed via email to 633 recipients. The survey consisted of 12 vignettes derived from real patient cases. Vignettes were reviewed by a medical director from a local insurance company, and decisions on accuracy were determined through consensus with the investigators. Diagnostic triage decisions were categorized as follows: (1) treat, (2) treat and refer, and (3) refer. Comparisons were made of the mean scores between licensed PTs and students. A linear regression model was used to determine if select participant characteristics predicted accuracy.

RESULTS: The overall survey response rate was 31.7% (n = 164). Accuracy for each triage category for all participants were as follows: 67% for treat cases, 40% for treat and refer cases, and 66% for refer cases. When grouping treat and refer and refer categories together, accuracy for referral decisions was 82% and 83% for PTs and PT students respectively. There was a statistically significant difference (F = .016) in the mean scores of PTs and students overall accuracy, with PTs demonstrating greater accuracy. Participant characteristics of years in practice, practice setting and entry-level degree were not found to be predictive of overall accuracy. Clinicians with orthopaedic specialization (OCS) demonstrated greater accuracy than non-OCS practitioners, although these findings were not statistically significant.

CONCLUSIONS: PTs and PT students demonstrate a moderate-high level of accuracy when screening patients with LBP. Accuracy was highest for decisions on the need for medical referral. Licensed physical therapists were more accurate compared to student physical therapists in diagnostic triage decisions. Although OCS practitioners appear to perform better than non-OCS practitioners, these differences were not statistically significant.

CLINICAL RELEVANCE: The results of this study support the role of PTs as primary care providers. The findings also suggest that current DPT education provides the requisite skills for PTs to practice in a direct access environment.

OP0196
PHYSICAL THERAPY MANAGEMENT OF A PATIENT WITH NEUROPATHIC OCULAR PAIN SYMPTOMS: A CASE REPORT
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BACKGROUND AND PURPOSE: Neuropathic ocular pain (NOP) is a rare condition which poses diagnostic and treatment challenges. There is limited evidence to guide the treatment of NOP in patients with dry eye symptoms. The purpose of the case report is to describe the rationale and outcomes of a physical therapy (PT) approach to the management of a patient with NOP and dry eye symptoms.

CASE DESCRIPTION: The patient was a 20-year-old man referred to PT for bilateral eye pain and hyperalgesia. His primary complaint was hypersensitivity to wind and cold, which began 4 years ago after undergoing a septoplasty. Due to the severity of his symptoms, he had diminished tolerance of being outdoors, attending college classes to study music, and playing the piano for extended periods of time. His self-management pri-
or to PT included adjusting his sleep schedule, limiting all activities, and wearing protective goggles to shield his eyes from external stimuli. The patient also had undergone extensive medical evaluations and a variety of interventions including steroid drops, artificial tears, and injections. The patient received minimal relief from these treatments, and was referred from ophthalmology to a pain management physician. The patient then began a multidisciplinary approach involving ophthalmology, pain management for pharmacological symptom control, and PT. Upon initial examination, he presented with pain ratings (NPR) ranging from 4 to 8/10, Pain Catastrophizing Scale (PCS) score of 31, and hyperalgesia of peri-orbital region. Using a bedside dynamic pain psychophysics test, consisting of repetitive pin prick to the peri-orbital region for 30 seconds, his NPR increased from 4 to 8 indicating an increased temporal summation response. He received 10 sessions of PT over 6 weeks. Treatment included: desensitization activities to the peri-orbital area, vestibular ocular and gaze exercises as a form of graded-activity with increased visual task complexity per patient, and graded-exposure of the cornea to external stimuli (ie, wind and cold).

OUTCOMES: After 10 visits, PCS score improved from 31 to 24 with a corresponding decrease in self-reported fear-avoidance behavior and anxiety. He also reported improved activity tolerance and decreased hyperalgesia. Moreover, temporal summation of pain was no longer noted with repetitive pin prick.

DISCUSSION: In this case study, a treatment approach aimed at addressing neuroplasticity was implemented for a patient with a complex psychosocial and pain profile and symptoms involving the ocular and peri-orbital region. Treatment resulted in improved activity tolerance and decreased hyperalgesia. The decreased temporal summation with a bedside psychophysical test indicates that the underlying mechanisms for his improvement were likely neural system adaptations. The patient also reported that he was not compliant with the graded-exposure protocol at home. Therefore, the treatment effect was likely not optimized. Even greater gains may have been realized by better compliance and a longer intervention period.


SELF-APPLIED VERSUS CLINICIAN-APPLIED TREATMENT FOR MYOFASCIAL TRIGGER POINTS

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PURPOSE/HYPOTHESIS: The purpose of this study was to assess the effectiveness of self-applied Thera Cane and clinician-applied Graston Technique treatment on active myofascial trigger points (MTrPs) in the upper trapezius (UT). The assessment measures included the Neck Disability Index (NDI), Deep Cervical Flexor Endurance Test (DCFET), Cervical Range of Motion (CROM), and Pain Pressure Threshold (PPT). We hypothesized that both treatment techniques will result in positive changes of assessment measures, with more significant outcomes following the clinician-applied Graston Technique treatment, when compared to the control group.

NUMBER OF SUBJECTS: This study consisted of 14 participants, 12 females and 2 males (average age, 26.07 years), with active MTrPs in the UT. All participants met the inclusion criteria and did not meet any exclusion criteria.

MATERIALS/METHODS: This study consisted of a double blind, randomized control trial. Following completion of preparticipation forms, each participant was assigned to 1 treatment group: Graston Technique, Thera Cane, or active stretching control group. On the first day, assessment measures were collected and participants received a 5-minute treatment session. On the third day, participants received a second 5-minute treatment session. On the sixth day, participants had all measurements reassessed.

RESULTS: Data were analyzed using paired t tests. Significant differences were found for the Graston Technique group in the affected UT pre/post PPT (P = .012), unaffected UT pre/post PPT (P = .023), and pre/post right rotation (P = .045). Significant differences were found for the Thera Cane group in pre/post DCFET (P = .001).

CONCLUSIONS: From this study, it can be concluded that clinician-applied Graston Technique for active MTrPs in the UT results in significant improvement in pain tolerance and CROM; whereas self-applied Thera Cane results in significant improvement in deep cervical flexor muscular endurance. As a result, the Graston Technique treatment may be beneficial for individuals with active MTrPs in the UT due to more significant outcomes.

CLINICAL RELEVANCE: Myofascial pain syndrome is a common cause of musculoskeletal impairments and is characterized by MTrPs, which commonly occur in postural muscles such as the UT. There is a wide range of MTrP treatment interventions, including the Graston Technique and Thera Cane. Based on the results of this study, in as few as two 5-minute treatment sessions the Graston Technique has been shown to produce more meaningful results in individuals with MTrPs when compared to Thera Cane. Therefore, the Graston Technique is a viable treatment option for individuals with MTrP related pain.

OPO198
RHOMBOID MINOR AND MAJOR MUSCLE THICKNESS CHANGES WITH POSITIONING

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PURPOSE/HYPOTHESIS: In a previous study we showed that the distance to lung tissue. The study did not, however, answer the question if this position changed muscle thickness. Therefore, this study was conducted to measure and determine differences in rhomboid minor and major muscle thickness when the shoulder is in (1) retracted and (2) not supinated to measure and determine differences in rhomboid minor and major muscle thickness when the shoulder is in (1) retracted and (2) not supinated.

NUMBER OF SUBJECTS: Sample of convenience of 60 subjects, mean age of 26 years.

MATERIALS/METHODS: In prone position, with the arms placed along the trunk, head nonrotated and slightly lowered, diagnostic ultrasound was used to visualize the areas of the rhomboid minor and rhomboid major muscles. The ultrasound transducer was placed longitudinally, just medially to the scapula’s vertebral border. The rhomboid minor was vi-
sualized just superior to the scapular spine, in the area of ribs 1 and 2, and the rhomboid major further distally, in the area of ribs 5 and 6. The sound head was placed onto the skin using minimal pressure, in order to produce the most accurate anatomical representation. Each subject was asked to continue to breathe normally while a 4-second ultrasound video was taken. These video recordings were stored for later analysis. This procedure was repeated twice for each location, each side, and with the shoulder in retracted and unsupported positions. Thickness of the 2 muscles was measured using the ultrasound machine’s internal software. The mean of the 2 measurements was used for statistical analysis. Student t test was employed to assess differences between muscle thickness on the dominant and nondominant side. Paired t tests were used to determine differences between the 2 prone positions.

RESULTS: There were no differences in muscle thickness between dominant and nondominant sides, so the data were collapsed into 1. The average thickness of the rhomboid minor was 0.8 cm without bolster, 1.18 cm with bolster, for the rhomboid major the measurements were 0.56 cm and 0.81 cm respectively. The differences of 0.38 cm and 0.25 cm were significant for both muscles (P<.0001).

CONCLUSIONS: Positioning the shoulder in a retracted position (ie, on a bolster) when dry needling the rhomboid muscles changes muscle thickness significantly and should be considered when dry needling.

CLINICAL RELEVANCE: The rhomboid muscles become thicker and therefore possibly more accessible for dry needling when the shoulder is placed in retracted position. Knowing this information could have implications on needling safety.

OUTCOMES IN PATIENTS WITH SHOULDER PAIN WITH COMORBID DIABETES MELLITUS TYPE 2: A CASE SERIES
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BACKGROUND AND PURPOSE: Studies show that subjects with diabetes are 5 times more likely to experience rotator cuff pathology than the general population. This case series looks to examine outcomes of individuals with diabetes mellitus when treated with the physical therapy management as supported by current evidence for healthy individuals.

CASE DESCRIPTION: Three participants were treated in an outpatient physical therapy clinic from December 2016 to May 2017, in Hendersonville, NC. All included presented with shoulder pain and comorbid diabetes mellitus type 2.

OUTCOMES: All 3 patients reported significant improvement in pain and disability per subjective outcome measurements. Patient 1 had a reduction of pain from 7/10 to 3/10, patient 2 from 8/10 to 2/10, and patient 3 experienced pain reduction from 6/10 to 1/10. Disability also reduced from 31% to 25%, 45% to 21%, and 61% to 28%, respectively in each patient. Objective shoulder range of motion measures in all 3 patients improved, however not to the level the therapist or the patients had hoped. Shoulder external rotation remained most limited, shoulder flexion improved minimally, and shoulder internal rotation showed most improvement in all 3 patients. Resting postural changes were observed in patients 1 and 3, however no change was noted in patient 2 due to his history of a thoracic compression fracture and chronic spinal stiffness. Total numbers of visits ranged from 12 to 19, lasting 60 to 90 minutes each. All patient successfully reached their predetermined goal of fishing, performing all work-related activities, and dressing without difficulty.

DISCUSSION: Subjective report of pain and disability improved following typical shoulder pain management. Objective measures of shoulder range of motion and posture improved minimally in all 3 patients, however did not meet normative values or goals set by therapist for the patients. Although symptoms improved, the root cause of the pain (range of motion and posture) had not improved significantly and will likely result in future recurring shoulder pain for the patient, showing that typical physical therapy management alone may not be sufficient treatment for patients with shoulder pain and comorbid diabetes mellitus type 2.

Stair climbing test demonstrates reduced time from 6.52 seconds per step to 2.02 seconds per step, a 69% improvement. A sample of 25 patients from January 2017, average total rehab cost is $5449.42, $3744.43 from postacute rehab. The Impact Factor is for this sample is 12.68 and the total value score is 3.39, integers greater than 1 indicate significant patient value.

**IMPORTANCE TO MEMBERS:** Measuring the Impact Factor and reducing variability results in high quality outcomes delivered to patients with reduced cost.

**OP0201**

**THE EFFECTIVENESS OF KINESIO TAPING FOR DECREASING PAIN IN THE CERVICAL REGION: A SYSTEMATIC REVIEW**

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**PURPOSE:** To evaluate the effectiveness of using Kinesio Taping to reduce pain in the cervical region for a variety of diagnoses and different taping techniques.

**DESCRIPTION:** Searches were completed between September 2016 and January 2017 using CINAHL, Medline, PEDro, and PubMed databases. Search terms that were used included: kinesio, kinesio tape, kinesio-taping, kinesio taping, kinesio-taping, kinesiology tape, kinesio tex tape, KTT, KT tape, neck, neck pain, cervical, and cervical pain. Four hundred fifty titles were collected, duplicates were removed, and the remaining results were assessed for inclusion and exclusion criteria. Methodological quality was assessed using the PEDro Scale. Data were extracted from 14 articles and grouped into 6 diagnosis categories, including: acute whiplash, mechanical neck dysfunction, upper trapezius dysfunction, myofascial pain syndrome, cervical spondylosis, and cervical dystonia. Level of evidence of these articles ranged between 1b and 2b, and the mean PEDro score was 7.64. The sample size of participants ranged between 22 and 76 patients (n = 732), and age of participants ranged between 18 and 76. Outcome measures used to monitor pain included the visual analog scale (VAS) and the Numeric Pain Rating Scale (NPRS). Seven studies compared Kinesio Taping alone to other treatments, while 5 studies coupled Kinesio Taping with exercise. Two studies used Kinesio Taping, exercise, and other modalities in combination.

**SUMMARY OF USE:** A significant reduction in cervical region pain was seen in 13 of the 14 studies reviewed that included Kinesio taping as part of the intervention. Studies showed that applying Kinesio Tape appropriately was more effective in reducing pain than sham applications of tape. Kinesio Taping was not as effective in reducing pain in patients with acute whiplash.

**IMPORTANCE TO MEMBERS:** Kinesio Taping has been found to be effective in decreasing pain for a variety of cervical region diagnoses. Kinesio Taping is a cost-effective technique that can be added to any clinical practice, as it has very few side effects and contraindications. Continued research is recommended to further examine Kinesio Taping effectiveness in conjunction with and compared to other common interventions.

**OP0202**

**MOVEMENT DIAGNOSIS AND MANAGEMENT OF A PROFESSIONAL CLARINET PLAYER WITH SHOULDER MULTIDIRECTIONAL INSTABILITY: A CASE REPORT**

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**BACKGROUND AND PURPOSE:** The purposes of this case report is to demonstrate how a systematic movement examination of the upper extremity can identify the cause of patient’s shoulder pain, to consider regional interdependency during shoulder examination by including cervical and thoracic spine assessment, and to emphasize a functional-based home exercise program for improving compliance.

**CASE DESCRIPTION:** A 25-year-old professional clarinet player had 2 subluxations of her right shoulder, with the most recent incident occurring 2 months ago while performing overhead press-up exercise with 15-pound dumbbell in each hand. Though she needed to practice the clarinet 5 hours daily, her practice time was limited to 1 hour due to onset of right shoulder pain. After a systematic movement examination, key findings indicated she had movement diagnosis of scapular internal rotation/anterior tilt with insufficient upward rotation as well as excessive humeral anterior glide. The contributing factors to her movement diagnoses were: stiff pectoralis minor, limited performance of serratus anterior and lower trapezius muscles, dominant rectus abdominis with thoracic kyphosis, and insufficient passive tension of the rotator cuff. Treatments included frequent correction of thoracic kyphosis/scapular anterior tilt and internal rotation, avoiding swayback posture in standing especially while practicing clarinet, improving ribcage expansion, isometric exercises of rotator cuff muscles at various shoulder positions with proper trunk and scapular alignment, and increasing scapular upward rotation through the ROM of her overhead reaching activities.

**OUTCOMES:** The clarinet player was seen for 16 visits over 2.5 months. At her final visit, she was able to practice the clarinet for 5 hours without right shoulder symptom, and had returned to light weight lifting in the gym without sense of shoulder instability. Her QuickDASH score improved from 40.9% to 0%, indicating no functional limitations. Subjectively, the patient and her clarinet coach noticed that the clarinet sound has improved due to optimal alignment and abdominal control. Pectoralis minor was still stiff but serratus anterior and lower trapezius muscle performance increased from 4+/5 to 5/5 and 4/5, respectively. Ribcage expansion (from maximum exhalation to maximum inhalation) increased from 1 inch to 2 inches. Her shoulder internal rotation ROM increased from 25° with humeral anterior glide impairment to 60° without humeral anterior glide.

**DISCUSSION:** A systematic movement examination helped to identify the cause of the shoulder pain in a professional clarinet player with multidirectional instability. Treatments were effective because scapulo-thoracic mobility increased, excessive glenohumeral joint movements were eliminated, adjacent regions’ alignment and muscle performance were addressed, and the home exercise program focused on functional corrections.

PURPOSE/HYPOTHESIS: The lateral step-down test is an established clinical evaluation tool to assess quality of movement in patients with knee disorders. However, this test has not been investigated in individuals after anterior cruciate ligament reconstruction (ACLR) in association with quantitative 3-D motion analysis. The primary purpose of this investigation was to determine the strength of association between visually-assessed quality of movement during the lateral step-down test and 3-D hip and knee kinematics in patients with a history of ACLR using 2 box heights. The secondary purpose was to compare 3-D kinematics between subgroups based on the presence or absence of faulty pelvic and knee alignment scores during the task.

NUMBER OF SUBJECTS: Twenty subjects at least 1 year post ACLR (18 female; mean ± SD age, 24.5 ± 4.6 years; body mass index, 23.4 ± 2.3 kg/m²; 56.6 ± 39.2 months since surgery) were tested.

MATERIALS/METHODS: Subjects performed the lateral step-down test on the surgical limb atop 4 and 6 inch tall boxes. A board-certified orthopaedic physical therapist scored overall quality of movement during the lateral step-down test using established criteria during 2-D video playback. Three-dimensional hip and knee kinematics were simultaneously collected using an 8 camera Vicon motion capture system. Associations between the overall score for quality of movement and the target kinematic variables were assessed using Spearman’s rank correlation coefficients. Separate Mann-Whitney U tests were used to compare each kinematic variable by groups determined by the observational ratings for the pelvis and knee. An alpha level of .05 was used for all statistical treatments. Only significant results across the box heights were deemed clinically relevant.

RESULTS: For the primary purpose, across box heights, overall 2-D quality of movement score significantly correlated (r = 0.47-0.57) with 3-D peak hip abduction (P = .009-.022) and hip internal rotation (P = .011-.039). For the secondary purpose, across box heights, the presence of faulty 2-D pelvic alignment differentiated a subgroup exhibiting less 3-D peak knee flexion (P = .001-.026), and the presence of faulty 2-D knee alignment differentiated a subgroup exhibiting greater 3-D peak hip adduction (P = .023-.044).

CONCLUSIONS: Overall 2-D quality of movement appears most closely related to aberrant hip mechanics. Poor 2-D pelvic alignment appears to relate to decreased 3-D knee flexion, and poor 2-D knee alignment appears most closely related to increased 3-D hip adduction.

CLINICAL RELEVANCE: These results suggest that poorer movement quality during the LSD test may reveal neuromuscular control deficits and compensatory strategies in those with a history of ACLR. Clinicians may consider using the lateral step-down test to assess and guide treatments of neuromuscular control deficits that manifest at the hip and knee.

OP204
THE EFFECT OF ANTPRONATION TAPING ON GAIT CHARACTERISTICS IN HEALTHY ADULTS: A PILOT STUDY
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PURPOSE/HYPOTHESIS: The purpose of this study was to determine the effects of an antipronation taping technique using nonstretch therapeutic tape on gait characteristics. This technique is commonly used to treat a variety of conditions related to overuse injuries of the lower limb due to abnormalities in foot position. Researchers hypothesized that there would be a difference in gait characteristics in participants ambulating with the tape versus without the tape.

NUMBER OF SUBJECTS: A convenience sample of 20 healthy asymptomatic adults between the ages of 22 and 30 years was asked to participate. All participants were free from foot and ankle deformities or impairments and were screened for cardiovascular disease.

MATERIALS/METHODS: Data were collected using the GAITRite electronic walkway system which can measure spatial and temporal gait characteristics and also includes pressure sensors. Each participant was given the same instructions. Participants ambulated barefoot on the GAITRite for a total of 5 trials. The fourth trial was used for data collection, allowing the participants to become familiar with the walkway and ambulate with their normal gait pattern. After the first 5 trials, tape was applied to each foot to prevent pronation during ambulation and then participants returned to the GAITRite to complete 5 trials with the antipronation tape in place.

RESULTS: Paired t tests were performed to compare the gait characteristics of participants ambulating with the antipronation tape versus barefoot walking. Significant differences were found for both right and left step length as well as for gait velocity. The step length was significantly decreased in both the left (mean difference, 0.7675 ± 1.320 cm; P = .0176) and right foot (mean difference, 0.7595 ± 1.084 cm; P = .0055) when ambulating with antipronation tape versus barefoot. Gait velocity was also significantly decreased in participants ambulating with antipronation taping versus barefoot (mean velocity difference, 2.985 ± 3.608 cm; P = .0015). The GAITRite system also recorded a decrease in pressure along the medial longitudinal arch during ambulation with antipronation taping when compared to barefoot walking.

CONCLUSIONS: Research has focused on the effects of antipronation taping on medial arch and foot position, plantar pressures and muscle activation, but little has been done to study the impact on gait characteristics. This study found antipronation taping has a significant effect on gait characteristics in asymptomatic participants. Further research should be done to examine the effects during ambulation and running, in larger populations, on varied surfaces, and over time.

CLINICAL RELEVANCE: When selecting the most effective therapeutic interventions, clinicians should consider all of the potential effects. Changes in gait secondary to treatment could hinder recovery or result in suboptimal outcomes if not appropriately addressed.
single assessment numerical evaluation score, body mass index, presence of low back pain, previous steroid use, and limited external rotation range of motion) had a significant relationship with sleep quality but the correlation values were under the threshold for low correlation. Factors not associated with sleep quality included age, sex, smoking status, medication or injection history, previous physical therapy, range of motion, depression, and diabetes. The 10 variables that had a relationship and identified as significantly associated with sleep quality were entered into a regression model. These variables had a multiple $r$ of 0.61 and a coefficient of determination of 0.37 indicating that 37% of the sleep quality score could be explained by these findings.

**CONCLUSIONS:** It appears that sleep quality improves as the subject progresses through the phases of adhesive capsulitis. Factors that have the greatest impact are generally nonmodifiable by the physical therapist (self-report of pain and function, health status, and disease stage). Further study on significant factors such as the presence of low back pain, limited external rotation range of motion, and high BMI may be influential variables that are amenable to physical therapy intervention.

**CLINICAL RELEVANCE:** Decreased sleep quality in patients with adhesive capsulitis is expected and multifactorial. Further study on modifiable variables associated with poor sleep quality should be explored.

### OP206

**THE INTERRELATIONSHIP BETWEEN FUNCTIONAL COMORBIDITIES AND REPORTED OUTCOME MEASURES IN LUMBAR REHABILITATION: CLINICAL IMPLICATIONS**

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**PURPOSE/HYPOTHESIS:** The purpose of this study was to (1) determine if combinations of functional comorbidities in lumbar spine rehabilitation patients, leads to higher or lower scores on the Modified Oswestry Disability Index (MODI) and (2) determine if a relationship exists between patient reported outcome measures.

**NUMBER OF SUBJECTS:** Two thousand four hundred thirty.

**MATERIALS/METHODS:** Retrospective analysis involving 90 therapist and 2430 patients receiving outpatient physical therapy for lumbar rehabilitation from January to December 2016 across 15 outpatient orthopedic clinics. Two separate analysis were conducted including an ANOVA and cluster analysis techniques (classification trees) to group comorbidities together based on MODI pretreatment and post treatment scores and relationships between outcome tools. Functional comorbidities were included in collection as described by the functional comorbidity index per patient report and medical history. The Modified Oswestry Disability Index and pain scores (VAS) were assessed pretreatment and at discharge. The Pain Catastrophizing Scale (PCS) was scored at initial evaluation and the global rating of change (GROC) was recorded at discharge.

**RESULTS:** The group with the lowest average change in MODI are people with arthritis and asthma. There was a group of 84 patients with both arthritis and asthma who had an average change in the MODI of 6 percentile points as compared to the 852 patients without either comorbidity where the average change was 11 percentile points. There was a group of 274 patients with both degenerative disc disease and arthritis, with an average change in the MODI of 7 percentile points as compared to the 753 patients without either comorbidity where the average change was 12 percentile points. The MODI difference is statistically correlated with the GROC score with a correlation coefficient of 0.400 ($P < .001$). There is a linear association of pain score and the GROC; as the reported pain level increases the GROC decreases (Spearman correlation coefficient = -0.402, $P < .001$). There is no statistically significant correlation between the MODI and the PCS ($P = .418$). Using a regression model for the MODI change and initially entering GROC then pain score, there was no additional modeling improvement by including pain score. Thus GROC and pain score provide similar information.

**CONCLUSIONS:** This study demonstrated the interrelationship between functional comorbidities in patients receiving physical therapy for lumbar pathology and the effect it can have on prognoses for a lower change in score on the Modified Oswestry Disability Index outcome measure. It also demonstrated the relationship between multiple patient reported outcome tools including the GROC, MODI, VAS, and PCS.

**CLINICAL RELEVANCE:** Greater understanding of patient specific variables which may influence prognosis for lumbar rehabilitation is an imperative subject for future research in order to reduce cost-utilization and improve effectiveness of intervention.

### OP207

**POOR MOVEMENT STRATEGIES ACCOMPANY SELF-REPORTED WALKING DIFFICULTY IN KNEE OSTEARTHRITIS**

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**PURPOSE/HYPOTHESIS:** Knee OA is the leading cause of self-reported walking difficulty.1 But, little is known about walking difficulty in knee OA making it hard to suggest interventions. OA related walking difficulty may be better understood via muscle use, such as cocontraction (CoC), or the simultaneous firing of flexors and extensors, strategies used during gait. Effective muscle use can provide joint stability and optimize movement.2 Ineffective muscle use can generate erratic forces and disturb movement smoothness.3 Poor movement smoothness is related to larger jerk, or the time derivative of linear acceleration.4 However, jerk and its relationship with CoC in knee OA are unknown. Therefore, the aims of this study are to examine jerk based on walking difficulty and knee OA; and to examine how walking difficulty affects the relationship between CoC and jerk. We hypothesize that jerk will be different based on walking difficulty and OA and that walking difficulty will moderate the relationship between CoC and jerk.

**NUMBER OF SUBJECTS:** Thirteen subjects, or 36 total, were age and sex matched for each group: walking difficulty with knee OA (Diff), no walking difficulty with knee OA (NoDiff), and no knee OA (control).

**MATERIALS/METHODS:** Subjects walked at 1.0 m/s with an inertial measurement unit (IMU) at the tibia and electromyography (EMG) electrodes on the lateral quadriceps (LQ), hamstrings (LH) and gastrocnemius (LG). Jerk was calculated as the first derivative of linear acceleration outputted from the IMU and CoC from LQ.LH and LQ.LG. OA subjects ranked walking difficulty on a 6-point scale from the Knee Outcome Survey. The Diff group included responses of 3 or less and the NoDiff included responses greater than 4. The $t$ test examined group differences. Two separate stepwise regression analyses examined the interaction effect.

**RESULTS:** Jerk was significantly different, as Diff group versus No Diff, $P = .01$, and versus Control, $P < .01$. For LQ.LH, main effects for group or jerk were not significant, $P > .05$, but group-jerk interaction was significant, $P = .02$. For LQ.LH, main effects for or jerk were not significant, $P > .05$, but group-jerk interaction was significant, $P = .03$.

**CONCLUSIONS:** Self-reported walking difficulty can explain the relationship between CoC and jerk, which suggest that the perception of walking ability in knee OA can affect the feed-forward system in a closed-loop neuromuscular system that dictates movement strategies. The results are derived from stance phase variables of controlled testing conditions suggesting a closed loop system.5 Neuromotor signals may be impacted by the perception of walking ability and creating poor movement strategies in the Diff group. Thus, this study provides insight into the neuromuscular and movement strategies that are relative to knee OA related walking difficulty.

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**OPO208**

**Utilizing Patient Outcomes and Clinically Meaningful Change to Assess the Effectiveness of Residency Training**

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**Purpose/Hypothesis:** Residencies continue to grow in popularity despite limited evidence supporting improvements in patient outcomes post training. Our purpose was to evaluate whether patient outcomes measured by Focus On Therapeutic Outcomes (FOTO), a national patient outcome assessment system, could be used to assess the effectiveness of residency training. We hypothesized that the percentage of patients who experienced clinically meaningful change (by exceeding the minimally important difference [MCID] on FOTO) would increase after residents completed region-specific didactic training.

**Number of Subjects:** Four residents (2 cohorts) enrolled in a 12-month residency, accredited by the American Board of Physical Therapy Residency and Fellowship Education, participated. Ninety-six patients treated between August 2014 and March 2016 (one and a half residency cycles) with complete FOTO data including intake, discharge score and number of treatment sessions were included.

**Materials/Methods:** A deidentified patient data set was obtained and analyzed to assess the percentage of patients (grouped by region of dysfunction) who exceeded the MCID for FOTO (coded as “success”) or not (“failure”) pre and post intervention. The intervention included didactic training in spinal dysfunction (SPD), upper quarter dysfunction (UQD) and lower quarter dysfunction (LQD) over the course of the residency year. Chi-square analysis was utilized to assess differences in frequency count. This study was approved by the Spaulding Rehabilitation Network Institutional Review Board.

**Results:** Forty-four patients presented with SPD, 14 with UQD and 38 with LQD. Fifty-seven percent of patients exceeded the FOTO MCID. The percentage of patients with SPD who had success before intervention was 40% compared to 47% post intervention. Patients with UQD had identical pre and post intervention success rates (50%). A greater percentage of patients with LQD experienced success pre intervention (76%) compared to post intervention (71%). Chi-square analysis revealed no statistically significant differences in frequency counts.

**Conclusions:** Analysis of patient outcomes from 1 residency revealed that a greater percentage of patients with SPD experienced clinically meaningful change when treated by an orthopaedic resident post SPD didactic training. This upward trend was not statistically significant. There was a downward trend in the percentage of patients with LQD who experienced success after intervention compared to before. However, the percentages of patients with LQD who experienced successes overall was promising.

**Limitations:** In this study included a small sample size and lack of a complete patient data set spanning the complete residency year for all residents. Analysis of a larger patient data set using logistic regression may provide insight into confounding variables.

**Clinical Relevance:** Monitoring patient outcomes is essential to evaluating the effectiveness of evidence-based care. Outcomes can also provide valuable information about the effectiveness of residency training.

**OPO210**

**Successful Management of Long-Term Costochondral Impairments through Manual Therapy and Specific Exercise: Resolving Secondary Compensations in Movement**

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**Background and Purpose:** Costochondritis is a painful condition with symptoms localized at the costochondral or interchondral joints. The prevalence of costochondritis is greater in females and athletes. The purpose of this case study is to describe the physical therapy management of a female recreational athlete with chronic costochondritis.

**Case Description:** The case involved a 24-year-old woman diagnosed with costochondritis presenting with lower left costochondral symptoms that had been recurrent since she concluded her collegiate volleyball career 2 years prior. The symptoms were exacerbated with upper extremity pushing or pulling during strength training or upon waking from sleeping on her left side. She had a history of self-manipulation for temporary relief of symptoms via thoracic extension with shoulder horizontal abduction. Examination of range of motion at the cervicothoracic spine and the shoulders was unremarkable, and she had no deficits in shoulder strength bilaterally. Muscle length assessment of the pectoralis major was unremarkable, while the pectoralis minor was found to be relatively stiff and short bilaterally. Palpation revealed prominent left costal cartilage at the sixth interchondral joint.
and seventh ribs and hypertrophy of the right thoracic paraspinal musculature compared to the left. Manual therapy assessment of the thoracic spine revealed mild restriction of right unilateral posterior-to-anterior glides at T4-T10. These findings indicated that the left costochondral hypermobility was correlated with the right thoracic hypomobility. Physical therapy management included education regarding the etiology of these symptoms and common outcomes as well as recommendation to cease self-manipulation. Manual therapy interventions included mid-thoracic posterior-to-anterior mobilizations in prone and seated thoracic distraction as well as a supine costovertebral mobilization technique. Exercise interventions emphasized soft tissue release and passive stretch of the pectoralis minor, and in later visits resisted cable rows and a push-up progression.

OUTCOMES: The primary outcome measures for this case were the numeric pain-rating scale (NPRS) for subjective pain and the global rating of change (GROC) scale to gauge perceived improvement. Resting NPRS scores were 2/10 at eval and 1/10 follow-up and 0/10 at 2-month follow-up. NPRS scores with activity decreased from 8/10 at eval to 6/10 at 1-month follow-up and eventually to 3/10 at 2-month follow-up. The GROC at 1-month follow-up was +3 and at 2-month follow-up was +5.

DISCUSSION: This case report adds to the small body of physical therapy literature regarding the clinical management of patients with costochondritis, which to date has been largely limited to case reports and case series. Much of the published literature includes a patient population with duration of symptoms of 6 months to a year, whereas this case report details the management of an individual whose symptoms were of a longer duration.


OP0211
IS IT TURF TOE OR ARTICULAR DERANGEMENT? A CASE REPORT
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BACKGROUND AND PURPOSE: Turf toe is defined as a hyperextension injury to the first metatarsophalangeal (MTP) joint. It is common in athletes landing from a jump or pushing off during a sprint. Depending on the grade of the sprain, return to activity occurs immediately or up to 8 weeks or longer. Rest, ice, use of a walking boot or stiff-soled shoe are commonly prescribed conservative interventions. The purpose of this case is to describe articular derangement as a possible alternative diagnosis and intervention process.

CASE DESCRIPTION: A 14-year-old adolescent girl was diagnosed with right turf toe following an injury when landing on her dorsiflexed toe during a volleyball game 2 years ago. Initial treatment consisted of immobilization in a walking boot, ice and ibuprofen. Her pain persisted whenever she played volleyball or attempted to run or squat. She used stiff-soled shoes and kinesiotape when physically active to limit her discomfort. After 2 years of pain with activity, the family decided to try physical therapy.

OUTCOMES: The client initially scored 39/80 on the Lower Extremity Functional Scale (LEFS) with chief complaints of pain with volleyball, running less than 1 minute and squatting. Her pain rating over the previous 24 hours was 2 at rest and 7 at worst. Client’s stated goals were to play volleyball and run without pain. Patient had 0° plantar flexion and 2° dorsiflexion at the right MTP. Attempted physiological movement of the joint was very painful. She had limited accessory motion and was very tender to palpation along the plantar aspect of right first MTP. Other ROM/strength of the right lower extremity was WNL. Grade III/IV+ joint mobilization to the first MTP restored the accessory motion. Repeated plantar flexion per McKenzie Mechanical Diagnosis and Therapy (MDT) demonstrated an immediate improvement in ability to both dorsiflex and plantar flex. She was less painful in both directions. Immediately after the repeated plantar flexion technique, the client was able to squat and run 2 minutes without significant pain. She had some signs of turf toe, but responded well to the MDT treatment for an articular derangement. She was seen for 3 more visits which included Grade III/IV+ joint mobs, repeated first MTP plantar flexion and 1 session of augmented soft tissue mobilization. At discharge, she had been playing volleyball for 2 weeks without restriction. ROM at the first MTP was WNL and pain free. She was using regular shoes and was no longer taping. Her LEFS was 76/80 and patient stated she feels normal again. A phone call at 2 months post discharge showed patient remained painfree and fully functional.

DISCUSSION: Turf toe has a well-defined mechanism of injury and clinical presentation. However, therapists need to examine all possible differential diagnoses to rule out other potential issues, especially when a patient falls outside the normal time frames for recovery. This case supports the potential of articular derangement as defined by the MDT System as an alternative diagnosis and intervention to turf toe.


OP0212
ACUTE EXACERBATION OF CONGESTIVE HEART FAILURE FOLLOWING TOTAL HIP ARTHROPLASTY IN THE OUTPATIENT SETTING
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BACKGROUND AND PURPOSE: According to the CDC, there are more than 332,000 THAs performed annually in the United States. Reducing length of stay has produced significant cost savings to the health care system. However, comorbid conditions among THA recipients contribute to post-operative complications following inpatient discharge. COPD, CHF, and CAD have been identified as major risk factors for medical complications following THA. Vital signs are an essential component of an initial evaluation in an outpatient setting, particularly for patients with cardiopulmonary comorbidities. An understanding of appropriate vital sign response during aerobic activity is required before engaging in exercise with THA patients. While 75% of orthopaedic physical therapists perform cardiovascular screening, less than 50% measure vital signs at rest or during exercise. Such practice is concerning given that physical activity is routinely prescribed by physical therapists for patients with concomitant musculoskeletal and cardiovascular conditions. This case demonstrates how clinical decision-making regarding vital signs assessment led to the diagnosis of an acute exacerbation of CHF following THA.

CASE DESCRIPTION: The patient is a 57-year-old man with hypertension, type II diabetes, and CHF who presents to physical therapy 8 weeks post THA. Following a 3-week hiatus after his initial evaluation, the patient reported ADL performance with fatigue and dyspnea at rest and with ambulation. Vital signs were obtained: rest 84% to 86% SpO2, ambi-
loration 71% to 77% SpO2. The patient was initially unwilling, but ultimately agreed to be transported to the emergency department. The patient was admitted to the ED for dyspnea and hypoxemia. The patient was provided with azithromycin, and transitioned to levofloxacin upon being admitted to the ICU. The patient was prescribed Lasix and released from the hospital after 4 days. Following discharge, the patient completed a successful 2-month rehab program to resume normal mobility functioning.

OUTCOMES: All preoperative studies were unremarkable. During the initial evaluation, vital signs were obtained: 171/96 BP, 107 HR, no dyspnea at rest or with low perceived rate of exertion. At follow-up: SpO2 84% to 86% rest, 71% to 77% during ambulation, 81% to 84% postambulation. The patient was referred to the ED, and subsequently admitted to the ICU. Upon return to physical therapy, all vitals were maintained at therapeutic levels during his course of care.

DISCUSSION: This case highlights the importance of routine assessment of vital signs for a patient postoperative THA with cardiovascular comorbidities. Consistent reassessment of at-risk patients during physical activity is essential for safe care, notably given that this patient was not provided with medication by his medical team due to being asymptomatic at time of surgery. As direct access providers, physical therapists can serve an important role in recognizing the progression of cardiovascular conditions and refer patients to the appropriate medical provider.


OP0214
WORK-RELATED MUSCULOSKELETAL INJURIES IN PHYSICAL THERAPY STUDENTS: A PILOT STUDY
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PURPOSE/HYPOTHESIS: Work-related musculoskeletal disorders (WMD) are common among physical therapists (PT) and often result in lost work time, work restriction, or transfer to other jobs.3,4 Considering that physical therapists are trained in body mechanics and injury prevention during their entry-level education, the incidence of WMD should be lower among PTs. However, evidence suggests that the WMD rates among PTs are comparable to other health professionals and even more, younger PTs (less than 5 years of practice) are more vulnerable to WMD.4,5 There is lack of knowledge on the WMD incidence among PT students and further, on how to prepare PT students for unpredictable physical demands at their future clinical rotations. Therefore, the purpose of this research study is to investigate the prevalence and severity of WMD in physical therapy students, contributing risk factors, and strategies and responses to minimize the risks of WMD.

NUMBER OF SUBJECTS: Twenty-two participants enrolled in physical therapy programs located in the state of Arizona and in their final phase of their respective program completed an online questionnaire.

MATERIALS/METHODS: An online survey was distributed to the participants that included 14 demographic questions, 16 work related injury questions, and 3 questions related to risk factors and management strategies for WMD. RESULTS: In total, One hundred fifty-seven participants responded to the survey and 22 participants responded “yes” to sustaining work-related musculoskeletal symptoms due to work in clinical rotations in the last 12 months. Lower back region (86.3%) showed the highest prevalence of symptoms followed by neck region (18.2%) and wrist/hand region (13.6%). Muscle strain (68.7%) was reported to be the most common type injury followed by ligament sprain. The outpatient clinic not affiliated with a hospital, health system, military or other government agency were analyzed using SPSS software to determine intraclass correlation coefficients (ICC), and the MDC95 was computed to determine the error threshold. Concurrent validity between methods was calculated using an ICC model 3,k and 95% limits of agreement (LOA) with the formula: mean difference ± 2 SD.

RESULTS: The intrarater ICC model 3,1 was 0.57 for MS and 0.63 for the SB. Interrater ICC model 2,1 was 0.54 for the MS and 0.66 for the SB. Mean adduction angles (from the horizontal plane) ranged from 7° to 10° with higher adduction readings for the MS. The mean difference between the 2 methods was 0.4°. The MDC95 of the intra and interrater reliability ranged from 9° to 11°. The concurrent validity between methods was ICC = 0.69 and 95% LOA varied from 9° to –8°.

CONCLUSIONS: There was a trend towards higher reliability with the SB when compared to MS. However, reliability was only moderate irrespective of stabilization method. Based on the MDC95, hip adduction changes from 9° to 11° are needed to exceed the threshold of error when documenting change, which may approach 100% of the measured hip adduction angles suggesting high measurement errors. Although the 2 methods differed by less than 1 degree, the 95% LOA values indicated a difference of 17°, which suggests a lack of interchangeability between the methods. This is further supported by moderate ICC values for concurrent validity.

CLINICAL RELEVANCE: Physical therapists may consider utilizing a SB if challenges exist to stabilize the pelvis. However, concurrent validity between methods was moderate and measurement error is high thus the 2 stabilization methods should not be used interchangeably. Moreover, physical therapists should be aware of the MDC95 values when documenting change as 9° to 11° is required to exceed the threshold of error. Future research is needed to identify methods for quantifying ITB length with reduced error and increased reliability.

OP0213
THE RELIABILITY AND CONCURRENT VALIDITY OF THE OBER TEST: EFFECT OF A STABILIZATION BELT
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PURPOSE/HYPOTHESIS: Iliotibial band (ITB) tightness is a postulated source of knee pathology and clinical efforts are often undertaken to improve ITB length. The Ober test (OT) is one procedure used to measure the length of the ITB. The OT is performed in sidelying with knee flexed to 90° as the tester passively adds the thigh. The procedure requires the tester to stabilize the pelvis in order to isolate ITB length. Difficulty maintaining pelvic stabilization may confound the tests reproducibility and validity. Thus, the purpose of this study was to assess the reliability, minimal detectable change (MDC95), and concurrent validity of the OT with manual stabilization (MS) and a stabilization belt (SB). The reliability of the OT with external pelvic stabilization has not been previously explored.

NUMBER OF SUBJECTS: Forty (80 extremities) asymptomatic adults, mean age of 25 years.

MATERIALS/METHODS: The OT was performed by measuring the passive hip adduction angle with a bubble inclinometer. Two researchers took measurements and test order (MS versus SB) was randomized. Data were analyzed using SPSS software to determine intraclass correlation coefficients (ICC), and the MDC95 was computed to determine the error threshold. Concurrent validity between methods was calculated using an ICC model 3,k and 95% limits of agreement (LOA) with the formula: mean difference ± 2 SD.
was reported to be the most common setting for sustaining a WMRD and performing repetitive activities and bending/twisting activities were most implicated for sustaining WMRD. Almost 69% of the participants did not report the injury as they felt that they could self-treat the injury. The most responses for how the injury was treated were rest (54.5%) and personal knowledge of physical therapy (45%). When asked what the clinic could do to help with WMRD, the majority indicated better caseload management, followed by risk awareness and ‘safe practice’ training, followed by proving more assistive tools.

CONCLUSIONS: While the percentage of PT students reporting musculoskeletal injuries from this survey is far from the percentage range reported by licensed and practicing PTs, there is evidence that injuries are occurring among PT students. The majority of students failed to report injuries that could lead to further complications in the future.

CLINICAL RELEVANCE: Knowledge about the types of injuries and the mechanisms that occur in PT students can affect how students are trained. Topics such as body mechanics, self-care, time management, and team treatment approaches can be addressed to prevent WMRD among PT students.

OPO215

BELIEFS ABOUT RISK FACTORS AND PREVENTION OF UPPER EXTREMITY INJURIES IN RECREATIONAL ROCK CLIMBERS: A DESCRIPTIVE STUDY

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PURPOSE/HYPOTHESIS: Rock climbing has become increasingly popular in the past 60 years, and with the advent and popularity of rock climbing gyms, the sport has become accessible to virtually anyone, anywhere.5–6 Despite the health benefits of rock climbing, both indoors and outside, there is a high prevalence of upper extremity injuries reported by climbers.9 It is currently unclear whether current beliefs and available evidence on injury prevention are inadequate, underutilized, incorrectly implemented, or unavailable to the rock climbing population.9–10 A better knowledge of climber’s practices and beliefs may lead to more effective injury prevention and treatment.9–10 Therefore, the purpose of this study was to describe the beliefs, opinions, and practices of rock climbers regarding injury prevention and management.

NUMBER OF SUBJECTS: One hundred five survey respondents who met inclusion criteria: rock climbing for at least 1 year, 18 years or older and rock-climb at least 2 days per week.

MATERIALS/METHODS: Links to an online survey were posted on the webpages of several indoor rock climbing gyms, outdoor stores, and on the social media pages of several individuals within the recreational rock climbing community. The survey consisted of 26 questions and was designed to gather information about each participant’s demographics, rock climbing experience and injury history, prevention and management practices and beliefs.

RESULTS: One hundred thirty-one rock climbers responded to the survey. Twenty-six responses were discarded because they did not meet the inclusion criteria. Of the remaining 105 participants (66 men, 39 women), approximately 75% have been climbing more than 5 years and over 90% have climbed at an intermediate, advanced or expert level. Of the 105 participants, 70% of the participants climbed regularly (2-6 d/wk for 10-12 mo/). Approximately, 90% of the participants had a climbing related injury; 30% of those were suffering from a current injury. About 70% of the survey participants took time off from rock climbing on a regular basis because of an injury, and 40% of those attributed it to a recurring condition. Of these individuals, all but 2 participants believed in taking preventative measures for preventing climbing related injuries. Responses to questions about injury prevention and management practices showed a wide variety, indicating areas where more research can be targeted.

CONCLUSIONS: Rock climbers believe that injuries from rock climbing can be prevented, however, many people have experienced upper extremity injuries, a large portion of which become recurring.

OPO216

WHEN IN DOUBT, REFER IT OUT: NEUROLOGIC TESTING AND SUBSEQUENT REFERRAL IN A PATIENT WITH UE AND LE COMPLAINTS WITH AN UNDIAGNOSED MYELOPATHY AND CERVICAL LESION

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BACKGROUND AND PURPOSE: The purpose of this abstract is to describe a patient case in which the clinical examination revealed signs and symptoms that were consistent with significant neurological findings and warranted referral back to primary care for further medical testing.

CASE DESCRIPTION: A 43-year-old right-handed man was referred to physical therapy by his primary care provider for reported complaints of right shoulder range of motion loss over the previous 2 to 3 months, sensations of muscle tension with numbness and tingling in RUE and RLE as well as burning sensations in LUE and LLE. Patient reported worsening function of RUE due to these complaints. Patient also reported muscle tension in B thigh muscles upon standing and walking. He denied any nausea/vomiting, loss of balance, or changes in vision or hearing. Patient had not undergone diagnostic testing for these complaints. Past medical history was significant for allergies, lumbar radiculopathy, and peroneal tendon repair secondary to chronic lateral ankle pain without a MOI. Shoulder Evaluation: positive impingement testing, strong and painful resisted external rotation of the R shoulder. Non Shoulder Related Testing: Upper Quarter Nerve Mobility testing did not recreate symptoms, deficits noted in thoracic mobility without symptom reproduction. Further Testing: Neurological screening revealed burning sensation to light touch along T1 dermatome on the left and hyperactive biceps, brachioradialis, triceps, patellar, and achilles deep tendon reflexes on the right as well as decreased grip strength in the right hand. Hoffmann’s, Babinski, and clonus tests were positive. Assessment of tone revealed spasticity in R triceps brachii muscle group only. Red Flag Concerns: Given these positive neurological findings, along with the patient’s subjective reporting of muscle tension with numbness and tingling in the RUE and RLE, burning in the L UE and L LE without a clear mechanism, the patient was referred back to his PCP for additional testing with recommendations to seek imaging and referral to a neurologist pending MD consideration.

OUTCOMES: Diagnostic testing was positive for a C5-6 disc herniation, as well as a spinal lesion. The patient was referred by his PCP to a neurosurgeon for care. Physical therapy was held at that time.

DISCUSSION: This case demonstrates the importance of screening for red flags with patients who have neurologic complaints in the UE and LE, completing appropriate neurological testing, and referring back to their MD when the testing suggests the need for further medical work up. In this specific case, PT treatment was held and the patient was referred to a neurosurgeon to determine the extent of the lesion and to develop a surgical plan moving forward. This case also highlights the ability of the physical therapist to play a significant role in red flag screening and diagnosis resulting in appropriate referral back to the physician.

OP0217

There is No Difference Between Eccentric and Concentric Strengthening Exercise in the Treatment of Rotator Cuff Tendinopathy: A Systematic Literature Review

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Purpose/Hypothesis: Evidence suggests that eccentric strength training is effective when treating tendinopathies in the lower extremity and wrist. However, there is little evidence regarding the outcomes of eccentric strength training when compared to concentric strength training in rotator cuff tendinopathy. The purpose of this literature review was to establish whether patients with rotator cuff tendinopathy experience better outcomes if treatment includes eccentric strengthening exercises versus only concentric strengthening exercises.

Number of Subjects: Not applicable.

Materials/Methods: Searches were conducted using MEDLINE, CINAHL, Cochrane, and Web of Science. Only studies comparing the outcomes of eccentric strengthening programs directly to those of concentric strengthening protocols in the treatment of patients with rotator cuff tendinopathy were included. Methodological quality of studies was performed using PEDro and OCEBM levels of evidence. Recommendations were developed and graded using the OCEBM system.

Results: Four studies met inclusion criteria. Primary outcomes in all 4 studies were shoulder pain, strength, and ROM, and upper extremity function. All 4 studies found no statistically significant differences between outcomes in patients who completed concentric exercises only compared to patients who completed eccentric exercises.

Conclusions: There appears to be no difference in outcomes for patients who perform eccentric as compared to concentric strengthening exercises. Thus, our recommendation is that the choice of concentric or eccentric strength exercises for treating rotator cuff tendinopathy should be made based on clinical judgment and the individual patient. Limitations of the articles in this review include small sample sizes, a lack of control groups, and inconsistent treatment design. Future studies are needed to guide best clinical practice.

Clinical Relevance: Exercise has been shown to be an effective intervention for the treatment of rotator cuff tendinopathy. Physical therapists may include concentric and eccentric strengthening exercises to the patient’s plan of care given that evidence supports the effectiveness of both types of exercises for improving treatment outcomes.

OP0218

The Short-Term Effect of Elastic Therapeutic Taping Using Rocktape and an Exercise Program on Scapular Alignment in Individuals with Rounded Shoulder Posture: A Pilot Study

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Purpose/Hypothesis: Rounded shoulder posture (RSP) is a common postural deviation with altered scapular position, noted in approximately 73% of individuals from 20 to 50 years of age. Recent studies suggest that kinesiotaping may be an effective adjunct in improving proprioception, scapular position and muscle imbalance in individuals with RSP. Rocktape is a new brand of taping proposed to offer greater adhesiveness, increased stretch capacity, postural correction and clinical benefits. The purpose of this pilot study was to determine the effect of elastic therapeutic taping (ETT), using Rocktape, on scapular alignment and pain in individuals with RSP.

Number of Subjects: Eighteen participants (mean ± SD age, 26.8 ± 10.0 years) recruited via convenience sampling and meeting the criteria for RSP completed the study.

Materials/Methods: A single group, pretest/post test study design was utilized. The 2-week treatment included both ETT, using Rocktape and a stretching/strengthening exercise program. On day 1, tape was applied and each participant received the exercise program with instructions for home exercises (2 times per day) and to complete a log diary. After 1 week, participants returned for retaping and the home exercise program with the log diary were reviewed. Outcome measures collected pre and post treatment included RSP, Total Scapular Distance (TSD), Normalized Scapular Abduction (NSA) Ratio, Lateral Scapular Slide Test (LSST), and numeric pain-rating scale (NPRS). RSP is the distance between the posterior aspect of the lateral acromion process and the examining table when lying supine. TSD is the distance from the inferior angle of the acromion to the spinous process of T3. NSA ratio was calculated by dividing TSD by the length of scapula. LSST was measured in 3 positions, from the inferior angle of the scapula to the spinous process of T7. NPRS ranges from 0 to 10, with 0 indicating no pain at all and 10 indicating the worst pain possible. Paired tests were conducted to assess the differences in measurements with time (P<.05).

Results: Following intervention, significant improvements were noted for RSP (P<.003), TSD (P<.005), and LSST Position 1 (P=.001) and Position 2 (P=.002). The changes observed in the NSA ratio and NPRS did not show statistical significance.

Conclusions: This pilot study showed that 2 weeks of ETT using Rocktape and exercise, demonstrated significant short-term improvements in certain measures of static and dynamic scapular alignment. A better biomechanical scapular alignment is reported to enhance functional outcomes. The sample size and lack of control group may limit the findings of the study.

Clinical Relevance: RSP is a postural deviation commonly observed in modern society. The findings of this pilot study may aid physical therapists to design effective treatment strategies in patients with RSP.

OP0219

The Use of Pilates-Based Exercise in the Treatment of a 24-Year-Old Patient with Persistent Low Back Pain Following Transforaminal Lumbar Interbody Fusion

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Background and Purpose: Low back pain (LBP) is the most commonly reported cause of disability in people under the age of 45 years and is estimated to occur in 60% to 70% of the adult population in the industrialized world. This case report describes the use of Pilates-based exercise (PBE) in the physical therapy management of a patient with persistent chronic low back pain (CLBP) following transforaminal lumbar interbody fusion.

Case Description: The patient was a 24-year-old woman with a 7-year history of LBP presenting 17-months following surgery and an unsuccessful course of physical therapy. The patient presented in the chronic phase of LBP with easily provoked pain and severe disability in functional physical tasks. Observation of the patient’s movement strategies and posture informed the therapist’s clinical impression of spine instability adjacent to the patient’s L5-S1 fusion. The aim of the examination was to determine...
the appropriate classification for the patient. The patient's examination was positive for the following 3 of the 4 positive predictor variables for stabilization exercise; younger than 40 years old, positive Gower's sign, and a positive prone instability test. The patient's examination findings also satisfied 4 of the 5 positive predictor variables for PBE intervention; trunk flexion ROM greater than 70°, left hip average rotation ROM greater than 40°, no leg symptoms, and BMI over 25 kg/m². The choice of intervention best suited to this client was guided by the examination and intake findings, as well as the CPR guidelines for PBE and for stabilization exercise. The patient's examination findings indicated that the PBE intervention had a greater likelihood of improving the patient's LBP symptoms (93%, stabilization 67%). The intervention for this patient followed the basic principles of the Pilates Method adapted to the rehabilitation environment. The treating therapist (LP) had 18 years of experience with this approach at the time of this case study. The staging format used in this case report is based on Porterfield and DeRosas Stages of Rehabilitation.

OUTCOMES: The PBE intervention lasted for 22 sessions during which the patient demonstrated complete resolution of right hip pain and remained with intermittent LBP (2/10 NPSRS) at discharge. Minimally Clinically Important Difference (MCID) levels for each self-reported outcome measure instruments were exceeded at discharge (95% improvement in SF-36, 80% improvement in FABQ, 55% reduction in Oswestry Disability Index and 75%-100% reduction in numeric rating scale). The patient returned to work with lifting restrictions.

DISCUSSION: Patients following spine surgery are often excluded in studies of spine stabilization and PBE exercise interventions. This case study describes the use of PBE in the treatment of a patient following spine fusion. Research to elucidate the impact of PBE on patients with CLBP is needed.


HIP ABDUCTOR STRENGTH IN RESPONSE TO VARIOUS SITTING POSTURES: A CONTROLLED LABORATORY STUDY

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PURPOSE/HYPOTHESIS: Hip muscle weakness is associated with a variety of lower extremity pathologies.1-4 The authors’ clinical observations have noted hip abductor muscle strength can change in response to a patient’s sitting posture. The slumped sitting (SS) posture has been noted to result in hip abductor strength decline while the erect sitting (ES) posture does not appear to have the same effect. The purpose of the study was to attempt to validate the clinically observed phenomenon. Therefore, the hypothesis is various sitting postures will effect hip abductor strength when controlling for the testing position.

NUMBER OF SUBJECTS: Fifty subjects aged 18 to 26 years.

MATERIALS/METHODS: The study used a 1-way repeated-measures design. Each subject assumed the prone lying (PL1) posture for 5 minutes after which the strength of the dominant hip abductors was immediately tested using a MicroFET3 handheld muscle testing dynamometer (HHTMD). Hip abductor muscle strength was tested in the sidelying position. Each subject returned to the side-lying position for subsequent hip abductor strength testing after 5 minutes in the ES posture, 5 additional minutes in the prone lying (PL2) position and 5 minutes in the SS posture. Subjects were randomized for order between the ES and SS postures to minimize learning and fatigue effects.

RESULTS: Mean strength values for each condition were normalized for each subject to the PL2 posture mean strength values to account for within group strength variances. Paired t test analysis demonstrated significance for hip abductor strength decline following the SS posture compared to each of the mean strength values following PL1, ES and PL2 postures (P<.05). The decrease in hip abductor strength following the SS posture was 6%. A frequency analysis revealed 28% of the subjects demonstrated greater than 10% decline in hip abductor strength following 5 minutes in the SS posture. The average strength deficit of those with greater than 10% decline was 16%.

CONCLUSIONS: The SS posture can have a direct effect on hip abductor strength. Hip abductor strength declined 6% following 5 minutes in the SS posture. A subpopulation of 28% demonstrated an average decline of 16% in hip abductor strength following 5 minutes in the SS posture. The strength decline appears to resolve over the short-term by returning to the PL posture.

CLINICAL RELEVANCE: Sitting posture should be considered when evaluating hip pathology, particularly conditions involving decreased hip abductor strength.

COMPARING MOTION-CAPTURE SYSTEMS FOR CLINICAL APPROPRIATENESS IN LOWER EXTREMITY FRONTAL PLANE MEASUREMENTS

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PURPOSE/HYPOTHESIS: The purpose of this study was to compare 4 independent motion analysis systems for capturing frontal plane hip motion during double limb squats (DLS) and single leg squats (SLS) movements.

NUMBER OF SUBJECTS: Fifteen.

MATERIALS/METHODS: Fifteen females with a mean ± SD age of 24.2 ± 1.27 years provided consent and were screened before data collection. Each participant performed 3 trials of both DLS and SLS which were simultaneously captured on 4 motion analysis systems (Qualysis, Myomotion, Dartfish, Hudl). Following data collection, frontal plane hip angles were determined at the point of peak knee flexion.

RESULTS: A 1-way ANOVA of frontal plane hip angles between the 4 motion analysis systems demonstrated significant differences (P<.05). Tukey post hoc analyses were conducted to identify statistical significance. No significant difference was found between Qualysis and Myomotion or between Dartfish and Hudl for both right and left lower extremity during both DLS and SLS. A significant difference was found between Qualysis, Dartfish and Hudl during both DLS (7.62 ± 21.71, 37.57 ± 17.05, −29.46 ± 15.56) and SLS (−11.52 ± 26.46, 12.7 ± 6.75, 12.04 ± 8.09). A significant difference was found between Myomotion, Dartfish and Hudl during both DLS (7.09 ± 8.83, 37.57 ± 17.05, −29.46 ± 15.56) and SLS (−20.6 ± 7.88, 12.7 ± 6.75, 12.04 ± 8.09).

CONCLUSIONS: Two-dimensional and 3-D motion analysis systems demonstrated similarity within their specific domains but cannot be compared due to differences in measurement and calculation methods for hip abduction angles.

CLINICAL RELEVANCE: This study comparing 2-D and 3-D motion analysis
systems demonstrated similarity within their specific domains but cannot be compared. In comparison to 2-D analysis, more appropriate, objective and substantial evidence is provided with 3-D motion analysis.

**OP0222**

IMMEDIATE INFLUENCE OF MANUAL PHYSICAL THERAPY ON QUADRICEPS MUSCLE FUNCTION

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**BACKGROUND AND PURPOSE:** Neuromuscular alterations, including decreased quadriceps muscle function, are common in patients with knee osteoarthritis (OA). The manual physical therapy approach to treatment of knee osteoarthritis decreases pain, improves function, changes end range rotational stiffness, improves response to gait perturbations, and reduces the incidence of total joint replacement. The purpose of this case series was to quantify baseline quadriceps muscle function and summarize changes in patients with knee OA following a single session of manual physical therapy treatment.

**CASE DESCRIPTION:** The study included 5 participants presenting to the physical therapy clinic at Brooke Army Medical Center with symptomatic knee OA. The mean age of the sample was 61.8 years, experiencing an average of 60.4 months of knee pain, with an average WOMAC score of 104.4. Subjective pain assessment and surface electromyography (EMG) data from the quadriceps and hamstrings were obtained during maximal isometric contraction at 0° and 60° of knee flexion both before and after a 30-minute manual physical therapy treatment session. Treatment consisted of a single session of joint and soft tissue mobilization directed at the patients’ movement impairments accompanied by reinforcing exercise.

**OUTCOMES:** Preintervention-to-postintervention comparisons averaged across the sample demonstrated improvement in peak torque (14.6 Nm, 11.2%) and EMG activity of the rectus femoris (22.41 mV, 12.1%) during the 3 maximal isometric trials. Pre to post intervention comparisons for EMG data collected during contractions in terminal knee extension demonstrated large improvements in mean amplitude for vastus medialis obliquus (23.8 mV, 29.9%), rectus femoris (14.3 mV, 25.5%), vastus lateralis (19.1 mV, 18.2%) and biceps femoris (9.8 mV, 24.6%). The numeric pain rating during contractions also improved from 3.4 pretreatment to 2.0 posttreatment for the contractions in terminal knee extension.

**DISCUSSION:** After a single session of manual physical therapy directed at the knee joint, quadriceps function (EMG activity and isometric strength) improved in a sample of participants with knee OA. These results provide insight into the dishibitory effects manual therapy may have on the quadriceps musculature. Neuromuscular dysfunction of the quadriceps results in reduced knee extensor torque, altered gait and ultimately hastens the progression of joint damage. Manual therapy treatment applied to the knee joint may improve the function of the quadriceps muscles and ultimately positively impact joint function, gait parameters and the progression of OA.

**REFERENCES:**


**OP0223**

ISOMETRIC STRENGTH TESTING: RELIABILITY AND VALIDITY OF A NOVEL TESTING DEVICE COMPARED TO A HANDHELD DYNAMOMETER

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**PURPOSE/HYPOTHESIS:** Objective measures that accurately quantify muscle strength are essential for determining improvements, return to sport/work, and effectiveness of care. Handheld dynamometry (HHD) has demonstrated a wide range of measurement error and validity, particularly when strength testing larger muscle groups. A strength-testing device that minimizes rater variability and improves validity, but is less costly than an isokinetic dynamometer is needed. A novel device (ND) that turns any already owned weight stack machine into an isometric strength-testing unit was developed to address these issues. The purposes of this study were to determine test retest reliability and concurrent validity of a novel muscle strength-testing device, in comparison to a commercially available HHD. We hypothesized that the ND would demonstrate smaller measurement error and better validity than the HHD.

**NUMBER OF SUBJECTS:** Twenty-nine participants (10 male; mean ± SD age, 28 ± 8 years; height, 1.7 ± 0.1 m; mass, 68 ± 11 kg) with no lower extremity injury or surgery.

**MATERIALS/METHODS:** Subjects were tested over 2 sessions, 3 to 14 days apart (average, 11 days). Three raters of varying experience assessed isometric quadriceps strength (dominant leg; 90° of knee flexion) using both devices. The same rater tested subjects in both sessions. Session 1: random device order; 5 isometric trials (2 practice, 3 recorded maximum effort); within-session retest of ND. Session 2: same protocol; plus 5 isometric trials of knee extension on an isokinetic device (gold standard). Average peak force (3 trials; Newtons) and same rater data were used for analysis. Intraclass correlation coefficients (ICC), standard error of measurement (SEM) and minimal detectable change (MDC) were calculated. Concurrent validity was assessed with paired t tests (P<.05) and Pearson r statistic.

**RESULTS:** Test-retest reliability between sessions was ICCND = 0.91 (95% CI: 0.80, 0.96; SEM, 25 N; MDCND, 57 N) for the HHD and 0.96 (95% CI: 0.91-0.98; SEM, 35N; MDCHHD, 82N) for the ND. ND within-session reliability was ICCND = 0.96 (95% CI: 0.92, 0.98; SEM, 34 N; MDCND, 80 N). Peak force values with the HHD were significantly lower (P = .02) and less correlated (r = 0.64) to the gold standard. ND peak force was not significantly different (P = .48) with a higher correlation (r = 0.75).

**CONCLUSIONS:** Both the HHD and ND demonstrate comparable test-retest reliability. However, the HHD underestimates maximum strength with a ceiling effect of approximately 450 N for our raters. Testers had difficulty stabilizing the HHD when force exceeded 450 N being unable to keep the test isometric greater than 50% of the time. The ND does not demonstrate a ceiling effect and has better concurrent validity than the HHD.

**CLINICAL RELEVANCE:** The novel strength-testing device more accurately asessed isometric quadriceps strength than the HHD. Accurately quantifying strength of the quadriceps and other larger muscle groups is critical.
DIFFERENTIAL DIAGNOSIS IN A PATIENT REFERRED TO PHYSICAL THERAPY FOR NECK PAIN AND DIZZINESS WITH ROTATION: ROLE OF THE PRIMARY CARE PHYSICAL THERAPIST

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BACKGROUND AND PURPOSE: Neck pain and dizziness from vertebral artery dissection (VAD) and cervical artery dysfunction (CAD) is serious, and needs to be approached with sound clinical reasoning. Proper screening for sinister pathologies in patients with neck pain and dizziness is extremely important in direct access practice, especially, manual physical therapy. Patients with neck pain and dizziness may have symptoms that mimic or overlap other conditions such as BPPV, Cervicogenic vertigo and VAD/CAD; however, treatment approaches are different. It is paramount the physical therapist (PT) adequately discern the presence of vascular flow disruption as a component of the symptoms. Bow Hunter’s syndrome (BHS) (rotational vertebral artery syndrome) is a rare cause of vertebrobasilar insufficiency that arises from mechanical compression of the vertebral artery by head rotation. Symptoms include: vertigo, nausea, dysarthria, dysphagia, transient blurring of vision, gait disturbance, headaches and other sensorimotor findings such as tinnitus, hearing loss, syncope, or drop attacks. BHS usually appears in the fifth to seventh decade of life. One reported case linked facet hypertrophy as a contributing factor. There is no standardized diagnostics regimen or treatment of BHS. The purpose of this case report is to present the findings of BHS so that PTs can adequately screen for this serious pathology and make appropriate referrals.

CASE DESCRIPTION: A 40-year-old man with neck pain presented to a hospital-based outpatient PT clinic after being referred by a physician’s assistant (PA). No prior medical imaging was performed. The patient reported neck pain and dizziness upon rotation. The complaints of dizziness had been present for 14 years but the neck pain was of more recent onset. Physical therapy was discontinued after 12 visits and the patient reported 0/10 pain and a 4% on cervicobasilar reflex (VOR) testing. PA joint mobilization was performed at C1 and C2 and the cervicothoracic junction. Upper cervical testing reproduced headache and neck discomfort. The patient could maintain 24 mmHg when performing the Craniovertebral Flexion Test (CCFT). Vestibular examination revealed impaired single leg stance bilaterally (less than 15 seconds) and complaints of unsteadiness performing vestibulo-ocular reflex (VOR) testing. PA joint mobilization was performed at C1 and C2 as well as the upper thoracic spine. A rotary manipulation of Co-C1 and C1-C2 and a supine upper thoracic manipulation were performed on 2 occasions. Deep neck flexor strengthening, joint position error training involving a laser and VOR exercises was also performed in a variety of positions to progress difficulty.

OUTCOMES: At visit 6, the patient’s neck pain was a 2/10 on the NPRS and he reported a reduced frequency of headaches. Physical therapy was discontinued after 12 visits and the patient reported 0/10 pain and a 4% on the NDI. Single leg stance could be held longer than 30 seconds and he was able to reach 30 mmHg on the CCFT. Cervical ROM was full in all planes and no pain was reported. Patient was able to begin running without headaches or dizziness for the first time since the injury and was not taking any medication to manage his symptoms.

DISCUSSION: A patient diagnosed with post concussion syndrome was successfully managed with a combination of cervical and thoracic manipulation, exercise and proprioceptive training. The cervical spine may be an important component of the pain and disability experienced by individuals with prolonged headache after concussion.

Combined Sections Meeting


**OP0226**

**THE EFFECTS OF DIRECT-ACCESS PHYSICAL THERAPY WITH GUIDELINE-ADHERENT CARE VERSUS TRADITIONAL ACCESS THROUGH PHYSICIAN REFERRAL ON COST UTILIZATION AND OUTCOME OF CARE IN CERVICAL SPINE RADICULOPATHY: A CASE REPORT**

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**BACKGROUND AND PURPOSE:** Current evidence suggests entering physical therapy (PT) through direct access and providing guideline adherent care decreases cost utilization and improves outcomes when compared to access through physician referral. Limited evidence exists which describes direct access, guideline adherent treatment, cost-utilization and timing of care specific to cervical spine radiculopathy.

**CASE DESCRIPTION:** The patient was a 39-year-old woman who presented to PT through physician referral with the diagnosis of acute cervical radiculopathy with complaints of right U.E. paresthesia. Patient reported a visit with her PCP who prescribed muscle relaxants, a cervical spine MRI and subsequently referred to PT. Examination findings included deficits with right cervical ROM, normal DTRs, deep neck flexor or endurance deficits, positive foraminal compression, distraction, and median nerve ULLT. Treatment included manual therapy to cervical and thoracic segments, deep neck flexor biofeedback training, cervical/scapular strengthening, median nerve flossing, a progressive home exercise program (HEP) and cervical spine mechanical traction. Once goals were met she was discharged to a HEP. Sixteen months from being discharged from PT, patient returned through direct access due to an acute onset of cervical spine symptoms that morning and was evaluated and provided treatment that same afternoon. Examination findings, complaints and treatment provided were the same a previous episode of care. Once goals were achieved she was discharged with a progressive HEP.

**OUTCOMES:** Physical therapy through physician referral included treatment for a total of 15 visits. Patients initial Neck Disability Index (NDI) was 3 raw points (0-50 scale) with a discharge NDI at 1 raw point. Initial pain was 5 points and rated at 0 at discharge with elimination of R U.E. paresthesia’s. Point of initiation of treatment was 60 days after initial complaints. Cost of care for patient was $594.30. Cost of care to third party payer was $584.27. Patients second episode of care through direct access included a total of 8 visits. Initial NDI was 8 raw points and was discharged with an NDI of 0 points and elimination of paresthesia’s. Initial pain was 2 points and discharged at 0 points. Point of initiation of treatment was day of onset of complaints. Cost of care for patient through direct access was $160.00. Cost of care to third party payer was $2581.52. Access to physical therapy through direct access saved patient $434.30 and savings of $3264.75 to third-party payer.

**DISCUSSION:** This case report describes cost efficiency and improved outcomes with a patient who presented to PT with cervical radiculopathy through direct access versus physician referral. Physicians, clinicians and third party payers should consider the value of timeliness of care and direct access on cost-utilization and improved outcomes with patients who present with cervical spine radiculopathy.

**REFERENCES:**


**OP0227**

**QUANTIFYING FRONTAL PLANE KNEE KINEMATICS IN SUBJECTS WITH ANTERIOR KNEE PAIN: THE RELIABILITY AND CONCURRENT VALIDITY OF 2-DIMENSIONAL MOTION ANALYSIS**

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**PURPOSE/HYPOTHESIS:** Two-dimensional analysis has the potential to identify individuals at risk for knee injury by measuring genu valgus during sport related tasks. The reliability of 2-D analysis in measuring genu valgus during a single leg hop test on individuals with anterior knee pain has not been examined. The purpose of this study was as follows: (1) to determine the reliability of a 2-D mobile application in measuring frontal plane knee valgus during a single-leg hop test in subjects with anterior knee pain and (2) to determine the interrater and intrarater reliability of visual analysis on subjects with anterior knee pain.

**NUMBER OF SUBJECTS:** Nineteen.

**MATERIALS/METHODS:** Nineteen subjects with anterior knee pain, (12 female, 7 male; average ± SD age, 28.5 ± 7.29 years) were recruited. Two investigators independently estimated the measure of genu valgus with visual observation alone during a video recording using the Sparkmotion iPad application. After the visual estimation, the investigators watched the video again using the software to pause the video and measure the amount of knee valgus with a virtual goniometer tool. Each of the 19 subjects performed the test 3 times on each leg for a total of 6 jumps. Interrater reliability was calculated using intraclass correlation coefficient (ICC) model 2,k and intrarater rater reliability using model 3,k. Minimal detectable change and concurrent validity were calculated.

**RESULTS:** The interrater reliability using the 2-D application had ICCs of 0.927 and 0.792 on the symptomatic and nonsymptomatic lower extremities respectively. The 95% limits of agreement were calculated by using the formula: 95% limits of agreement = mean difference ± 1.96*standard deviation. Visual observation alone reported ICCs of 0.682 and 0.685 on the symptomatic and nonsymptomatic lower extremities respectively. The concurrent validity for 2-D analysis and visual observation on the symptomatic lower extremity had ICC values of 0.96 (rater A) and 0.85 (rater B). The nonsymptomatic lower extremity demonstrated concurrent validity ICC values of 0.95 (rater A) and 0.65 (rater B).
CONCLUSIONS: In this study, higher reliability was demonstrated while using a 2-D application when compared with visual observation alone. When 3-D motion analysis is not available, this study demonstrated that a mobile application could be used as a reliable tool when measuring dynamic knee valgus during a single leg hop test in subjects with anterior knee pain. Although good reliability was noted in the nonsymptomatic extremity, higher reliability values were achieved when measuring genu valgus on the symptomatic lower extremity. When identifying at risk individuals, this study supports the use of 2-D mobile applications as a reliable tool for injury screening.

CLINICAL RELEVANCE: The results of this study demonstrate increased reliability and decreased standard error of measurement when utilizing video analysis versus visual observation alone to measure genu valgus during a single leg hop. Two-dimensional analysis may reliably identify individuals who are “high risk” for injury.

OP0229
CARDIOVASCULAR SCREENING AND MEDICAL MANAGEMENT OF A PATIENT REFERRED TO PHYSICAL THERAPY
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BACKGROUND AND PURPOSE: The Guide to Physical Therapist Practice identifies the assessment of vital signs such as heart rate (HR) and blood pressure (BP) as an essential part of every patient assessment. A majority of therapists agree that measurement of HR and BP should be included in physical therapy screening. However, several studies to date have determined that outpatient physical therapists do not adhere to these practice guidelines with reported or observed adherence ranging from 2.7% to 6.0%. The purpose of this case report is to present an unusual presentation of emergent cardiovascular distress, illustrate the necessity of vital sign assessment, and describe the clinical reasoning which led to immediate referral of the patient to the ED.

CASE DESCRIPTION: The patient was a 62-year-old woman referred to an outpatient clinic for “low back pain,” with 2-year history of symptoms. P1: constant, unrelenting central upper thoracic pain. Constant 9/10 on NPRS. AGG: no discernible factors. EASE: no discernible factors P2: intermittent and variable low back pain, ranged from 0/10 to 6/10 on NPRS. AGG: sitting greater than 30 minutes, standing greater than 10 minutes. EASE: laying supine greater than 15 minutes, moist heat Oswetry was 80%, BP was 160/110, HR was 168, SpO2 was 98%.

During the assessment of blood pressure, the systolic loudness was noted to change significantly. No change or irregularity was noted in the pulse. Upon examination of the jugular vein and carotid artery, the patient was noted to have prominent jugular vein L greater than R with pulsation grossly visible. Clinical decision making: immediately following subjective history taking and assessment of vital signs and while in a seated resting position, the patient reported that she began to feel lightheaded, nauseated, and short of breath as well as noting intermittent loss of vision. The patient was brought to a semi-Fowler position and vital signs were re-assessed and found to be as follows: BP was 164/110, HR was 165, SpO2 was 98%. After 3 minutes of rest in the semi-Fowler position, the patient reported increasing symptoms of lightheadedness as well as increased nausea. At this point, the evaluating therapist determined that secondary to further progression of patient symptoms as well as irregularities in systolic loudness and jugular veins, immediate referral to the ED was warranted.

OUTCOMES: The EMS was activated, the patient was taken to the ED, and was diagnosed with ventricular tachycardia. The patient’s condition deteriorated to pulseless ventricular tachycardia and required defibrillation to restore normal sinus rhythm. The patient was kept overnight for observation before being discharged with instructions to follow-up with her PCP the next day.

DISCUSSION: This case is intended to illustrate the necessity of vital sign assessment including HR and BP in routine outpatient practice as well as describe a case of emergent cardiovascular distress which required immediate referral to the ED. Clinicians should strongly consider adherence to practice guidelines in the assessment of HR and BP upon initial evaluation of every patient.

CERVICAL SPINE THRUST JOINT MANIPULATION, EDUCATION, AND A HOME EXERCISE PROGRAM FOR THE MANAGEMENT OF INDIVIDUALS WITH TEMPOROMANDIBULAR DISORDER: A PROSPECTIVE CASE SERIES

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BACKGROUND AND PURPOSE: Temporomandibular disorder (TMD) is a common and costly problem affecting up to 60% of the population. TMD is recognized as the third most common chronic pain condition, leading to potential effects on function and quality of life. Only 5% to 10% of individuals with TMD seek treatment, frequently limited to dental occlusal appliances or medication. Currently, evidence supporting potentially effective physical therapy interventions in the management of TMD is limited and lacking. There is some support for interventions including multimodal treatment, manual therapy to the neck and jaw, behavioral modification, and therapeutic exercise. Limited quality evidence supporting effective interventions may act as a barrier to treatment in this population. The purpose of this case series was to describe outcomes in participants with TMD treated with a multimodal approach of manual cervical spine thrust joint manipulation, education, and exercise.

CASE DESCRIPTION: Five participants (4 female; mean age, 27 years; symptom duration, 2.2 years) agreed to participate in this case series. Diagnostic criteria for TMD (DC/TMD) confirmed diagnosis. All participants were treated with atlanto-occipital and C2-3 cervical spine thrust joint manipulation, behavioral education, and a home exercise program in 3 visits over 4 weeks. Primary outcome measures included maximal mouth opening (MMO), numeric pain-rating scale, Jaw Functional Limitation Scale (JFLS), and global rating of change (GROC). Secondary outcome measures were cervical range of motion (ROM), pain pressure threshold (PPT), Neck Disability index, and TMD Disability Index. Measurements were recorded at baseline, immediately following thrust joint manipulation, week 1, and week 4.

OUTCOMES: Friedman’s related-samples test showed statistically significant change in right cervical rotation (P = .034) and PPT of right temporomandibular muscle (P = .026). Clinically meaningful change was noted in cervical and jaw ROM. All participants reported improvement in function, and 4 of 5 participants had decreased JFLS scores at 4 weeks. Three of 5 participants (60%) reported symptoms at least “moderately better” (greater than 4 on the GROC). No reported adverse events or participants lost to follow-up.

DISCUSSION: All participants had pain at least 1 year in duration indicating spontaneous recovery was unlikely. Two of 5 participants demonstrated clinically meaningful change across multiple outcomes tested (NPRS, GROC, ND1). While cause and effect relationships cannot be determined, outcomes from this study indicate the approach may be effective in the TMD population. Future randomized clinical trials examining specific manual interventions or exercises with larger samples are necessary to confirm this hypothesis.


COMPARISON OF PRESCRIPTION OPIOID AND MANUAL THERAPY USE ON 1-YEAR HEALTH CARE COSTS IN PATIENTS WITH SPINE AND SHOULDER PAIN

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PURPOSE/HYPOTHESIS: The purpose of this study was to compare 1-year downstream health care cost in patients that received only manual therapy versus manual therapy and opioid prescriptions. In patients that received both manual therapy and opioid prescriptions, we evaluated differences in downstream costs based on which treatment was received first.

NUMBER OF SUBJECTS: One thousand eight hundred eighty-three patients seeking care for spine or shoulder disorders in a single military hospital.

MATERIALS/METHODS: This study involved person-level data from the Military Health System Management and Reporting Tool (M2) database. Patients with a spine or shoulder diagnosis and no pre-existing spine or shoulder visit in the 12 months prior were abstracted from M2, and then those that received at least 1 visit for manual therapy at any point in the 12 months after diagnosis made up the final cohort. Manual therapy was identified by way of Current Procedural Terminology (CPT) codes: 97140, 98925 to 98929, and 98940 to 98943. Outcome variables included total outpatient health care costs and opioid utilization over 1 year. The co-morbidities of metabolic disorders, mental health, chronic pain diagnoses, sleep disorders, and substance abuse disorders present after initial diagnosis, and opiate prescriptions in the 1 year prior to initial diagnosis, were used as control measures. Generalized linear models with gamma log links were run due to the heavily skewed nature of cost data. Point estimates with 95% Confidence Intervals were reported, and significance was set at α<.05.

RESULTS: From 1883 unique patients receiving manual therapy, 1165 (61.9%) also had prescription opioids. Mean 1-year costs in the MT-only group ($5812; 95% CI: $5447, $6200) were significantly lower (<0.00) than in the MT+opioid group ($13281; 95% CI: $12636, $13960). In those that had both treatments, mean 1-year costs in the MT-first ($1114; 95% CI: $10753, $12323) were significantly lower (<0.000) than opioid-first ($14453; 95% CI: $13746, $15290), and MT-first had significantly less mean days supply of opioids (34.3 days versus 93.3 days supply, <0.000) and mean unique opioid prescriptions (3.1 versus 8.21, <0.000).
CONCLUSIONS: Timing of care delivery decisions may affect downstream health care utilization and costs. Manual therapy first resulted in significantly reduced 1-year medical costs compared to opioid prescription first. In patients that received only manual therapy, their overall 1-year health care costs were less than half of those that also received opioids. This is observational data and our findings do not imply causality. These findings need validation in prospective studies that can assess if self-reported function and disability also improve when health care costs go down. While we adjusted for some comorbidities, there may be others we did not consider that adversely skew costs for prescription opioid users.

CLINICAL RELEVANCE: Nonopioid pain management strategies may reduce downstream health care utilization and should be part of the risk to benefit assessment when considering optimal treatment.

OP0232
CHARACTERIZATION OF SUBJECTS WITH SHOULDER PAIN BASED ON THE PAINFUL ARC AND SCAPULAR ASSISTANCE TEST
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PURPOSE/HYPOTHESIS: Shoulder pain affects up to 30% of the general population. The Scapular Assistance Test (SAT) is usually performed in those with painful arc during arm elevation. This test is suggested to identify if scapular motion may be related to shoulder pain and guide future strategies of intervention. However, patients with shoulder pain may present differences in the clinical presentation that may lead to different focus on intervention. This study described variables regarding painful arc, scapular assistance, scapular dyskinesis, duration of pain and function in subjects with shoulder pain.

NUMBER OF SUBJECTS: One hundred forty-two (83 male; average ± SD age, 39.70 ± 15.61 years; range, 18-77 years; duration of pain, 34.82 ± 55.92 months; range, 1-360 months).

MATERIALS/METHODS: All subjects had unilateral shoulder pain for at least 4 weeks and underwent the following clinical examination: (1) painful arc was evaluated during nonweighted arm flexion using a digital inclinometer; (2) SAT was performed in those with positive painful arc and considered positive when subjects reported a reduction of at least 2 points in the numerical pain rating scale (NPRS); (3) scapular dyskinesis was visually assessed during bilateral and nonweighted arm flexion; and (4) the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire was completed to assess upper limb function. Scapular dyskinesis was described using frequency distribution. Subjects were categorized as negative painful arc (n = 58), positive SAT (n = 51) and negative SAT (n = 33). One-way ANOVA and Kruskal-Wallis were used to compare DASH score and the duration of pain, respectively, among the groups. Tukey post hoc test was used when necessary. Independent t test was used to compare the onset of the painful arc between subjects with positive and negative SAT. A P < .05 was considered as statistically significant.

RESULTS: Scapular dyskinesis was present in 62.1%, 72.5% and 66.7% of the subjects in the negative painful arc, positive and negative SAT group, respectively. There was no difference (P = .11) in the duration of pain among the groups. Subjects with negative SAT presented worse (P = .017) DASH score than subjects with positive SAT (mean difference, 9.54) and negative SAT (mean difference, 13.76). Subjects with positive SAT demonstrated onset of pain later (P = .02) in the range of arm flexion (131° ± 32°) as compared to those with negative SAT (113° ± 40°).

CONCLUSIONS: Most subjects with unilateral shoulder pain presented positive painful arc. Higher prevalence of scapular dyskinesis and pain later in the range of arm flexion was demonstrated with positive SAT. Subjects with negative SAT showed worse function than others.

CLINICAL RELEVANCE: These data may assist the clinician in the decision-making process. Compensatory mechanisms may have contributed to better function in subjects with positive SAT as their painful arc starts later in the range of motion. However, research is still needed to determine the validity of this categorization and how SAT may help in the selection of specific exercises.

OP0233
EARLY USE OF FEEDBACK CUES IMPROVES GAIT AND FUNCTIONAL OUTCOMES IN A PATIENT AFTER DOUBLE ARTHRODESIS
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BACKGROUND AND PURPOSE: Double arthrodesis (DA) is a surgical procedure to correct planovalgus deformities of the foot and ankle by fusion of the subtalar and talonavicular joints. Recent kinematic studies post DA indicate changes in loading mechanics of the foot during mid-stance of gait leading to long-term concerns for arthritis and further debility. Loading changes include increased force in the lateral hind and midfoot, lateral shift of the gait line and overloading of the fifth metatarsal. Minimal research currently exists for physical therapy and DA. This case demonstrates a novel approach of supplementing therapeutic exercise with early use of feedback cues to improve load distribution in a patient after DA with primary complaints of lateral foot and heel pain.

CASE DESCRIPTION: Patient is a 67-year-old woman with history of bilateral congenital planovalgus deformity leading to multiple falls and poor quality of life. She received a DA with first metatarsophalangeal joint (FMTP) fusion 1 year ago on her left foot with an uncomplicated recovery. Her right foot was operated 13 months later with full weight bearing allowed at 3 months. After 2 weeks of ambulation the patient reported pain in her right heel, lateral foot and fifth digit severely limiting her function. Gait deviations on the right included a positive Trendelenburg, increased contact angle at heel strike, lateral weight shifting, decreased pronation and FMTP push off. Load distribution during walking was quantified with a pressure measuring device (EmedX, Novel Inc.) and supported increased heel and lateral column loading (200 and 170 kPa respectively) and no FMTP loading. Manual muscle testing (MMT) of the FMTP was 3/5 and the peroneus longus was 2/5. Timed up-and-go (TUG) score indicated falls risk at 25 seconds. She measured 755 ft on the 6-minute walk test (6MWT) and gait speed (GS) was 0.69 m per second. Interventions supplementing therapeutic exercise included tactile feedback via manually resisted exercises, weight shifting feedback using the EmedX measuring device and closed chain therapeutic exercise with focus on FMTP pronation.

OUTCOMES: The patient was seen a total of 8 sessions. MMT of the FMTP improved to 4/5 and peroneus longus to 3–/5. TUG, 6MWT and GS scores increased by 32%, 55% and 55% respectively, and were within age-matched norms. Plantar pressure measurements during walking revealed improved load redistribution with 18% decreased load on the heel and lateral column and 15% increased weight distribution through the FMTP joint. Trendelenburg and lateral weight shifting were both absent with gait assessment and the patient reported resolution of pain.

DISCUSSION: Limited evidence exist guiding early rehabilitation in DA. This case study describes positive outcomes accompanying a novel multimodal intervention that included feedback enhanced therapeutic exercise. Future research is needed to determine if the early use of feedback cues to improve gait kinematics will influence long-term outcomes in this patient population.

Improvements in self-reported function were not related to changes in painful movement patterns of the SFMA. CONCLUSIONS: The SFMA is the first step toward determining validity of the assessment. To our knowledge, this is the first study that has examined correlation of self-reported outcome measures and the SFMA across multiple body regions.

OP0234

CORRELATION OF SELF-REPORTED OUTCOME MEASURES AND THE SELECTIVE FUNCTIONAL MOVEMENT ASSESSMENT: AN EXPLORATION OF VALIDITY

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PURPOSE/HYPOTHESIS: The Selective Functional Movement Assessment (SFMA) is a clinical assessment model used to assist patient diagnosis and treatment plan development by identifying dysfunctions in fundamental movement patterns. If a movement-based assessment is a valid means of influencing patient outcomes, then it is logical that a change in self-reported function would lead to some degree of change in movement. The purpose of this study was to explore the validity of the SFMA by determining if a correlation exists between a change in self-reported outcome measures and attributes of the assessment. Our hypothesis was that a change in self-reported outcome measures would be correlated with changes in parameters of the SFMA.

NUMBER OF SUBJECTS: Eighty-nine.

MATERIALS/METHODS: A convenience sample of 89 clinical subjects (mean ± SD age, 20.3 ± 1.6 years) was administered the patient-specific functional scale and a region-specific outcome measure followed by the SFMA top-tier movements. Following 6 weeks of therapy or when deemed appropriate for discharge by an independent physical therapist, each subject repeated the outcome measures and was re-evaluated on the top-tier tests by the same initial assessor who was blinded to the subject's self-reported outcomes. Correlations between changes in outcome measures, number of painful movements and measures of movement quality (number of dysfunctional movements and criterion scores) were calculated with Spearman rank correlation coefficients. Subjects were analyzed as a consolidated group and by each region based on primary complaint.

RESULTS: Fair to good positive correlations between improvements in self-reported outcomes and decreases in the number of painful patterns were noted for the complete dataset and for those with shoulder girdle and lumbo pelvic complaints (r = 0.28, 0.52, and 0.41, respectively). Subjects with lumbo pelvic complaints demonstrated fair positive correlations with improvements in self-reported outcomes and decreases in the number of dysfunctional patterns (r = 0.41 and 0.46). No correlations between changes in outcome measures and SFMA criterion score were observed.

CONCLUSIONS: Improvements in self-reported function were related to changes in movement quality, except for subjects presenting with lumbo pelvic complaints. These data suggest that movement quality in the SFMA in this sample of patients is an attribute independent from, or at least not strongly influenced by, self-reported function.

CLINICAL RELEVANCE: Establishing a relationship between outcome measures and the SFMA is the first step toward determining validity of the assessment. To our knowledge, this is the first study that has examined correlation of self-reported outcome measures and the SFMA across multiple body regions.

OP0235

USE OF NEUROMUSCULAR ELECTRICAL STIMULATION TO FACILITATE LUMBAR MULTIFIDUS ACTIVATION FOLLOWING A LUMBAR MEDIAL BRANCH RADIOFREQUENCY ABLATION

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BACKGROUND AND PURPOSE: Chronic low back pain (CLBP) is a significant cause of disability and economic burden in the United States. Impaired lumbar paraspinal (LPS) muscle function, including reduced cross sectional area (CSA) and increased fatty infiltration, has been associated with CLBP. A lumbar medial branch radiofrequency ablation (RFA) is a procedure first described in 1975 for treatment of spinal facet mediated chronic low back pain. Radiofrequency neurectomy has been shown to cause initial denervation of the Lumbar Multifidi (LM). These impairments may be associated with reduced force generation, which in turn may impair LPS function. Poor LPS size and function has been associated with chronic low back pain. Use of neuromuscular electrical stimulation (NMES) has been associated with improvements in muscle CSA, strength, and function following anterior cruciate ligament reconstruction and total knee arthroplasty. Use of NMES to improve LM activation following a RFA has not been investigated. Purpose: To explore the effect of NMES to the LPS musculature in a patient that underwent a medial branch RFA.

CASE DESCRIPTION: A 47-year-old woman with a history of chronic low back pain received a bilateral L4-L5 medial branch RFA. She presented to physical therapy 3 weeks following the procedure. Initial interventions were performed with the goal of increasing her LM muscle activation, trunk control, lumbar segmental mobility, hip mobility, and hip strength. After 3 sessions of treatment, the patient presented with no LM activation during a prone multifidus lift test (MLT) maneuver at her lower lumbar segments. The MLT has been shown to be a reliable and valid measure of LM activation at the L4-L5 level. At this time the decision was made to initiate NMES to the LM to facilitate a LM contraction. The NMES parameters were similar to previous research at the knee: 10 minutes, 12 seconds on, 30 seconds off, 400 microseconds, 75 pps, 2-second ramp, intensity increased to maximum tolerance after a visible muscle contraction.

OUTCOMES: The patient presented with a palpable LM contraction using the prone MLT at the L4-L5 level immediately following the NMES intervention. The patient maintained good LM activation at 1 week and 5 weeks following the addition of NMES. Votlional exercises were initiated to maintain the increased activation. Patient reported decreased low back pain with daily activity and gardening (6/10 to 3/10 on average) following the addition of NMES. After 10 sessions, her ODI decreased from 38% to 28% and her global rating of change score was “gotten moderately better.”

DISCUSSION: Increased LM activation occurred immediately following NMES to the lower LPS musculature. We found the use of NMES improved the patient’s ability to activate her LM. The increased LM activation was maintained 5 weeks following the NMES intervention. NMES may be an effective intervention when coupled with trunk stabilization exercises to increase LM activation following a lumbar medial branch RFA.

Combined Sections Meeting


OPO236

QUADRICEPS MUSCLE QUICKNESS RELATES TO FUNCTION IN PEOPLE WITH KNEE OSTEOARTHRITIS

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PURPOSE/HYPOTHESIS: The purpose was to determine if individuals with knee OA generate force more slowly than controls and if the time to peak force relates to function. We hypothesized that: (1) individuals with knee OA would have longer times to peak force and (2) longer time to peak force would relate to worse function in the OA subjects.

NUMBER OF SUBJECTS: Forty-five subjects (24 OA: mean ± SD age, 65.1 ± 7.4 years; 21 control: age, 62.9 ± 7.8 years) were studied in this analysis.

MATERIALS/METHODS: Subjects performed rapid force pulses varying from approximately 10% to 80% of the maximum force during an isometric contraction (MVIC). Force and RFDb were collected from 90 to 100 individual pulses and data were normalized to the maximum voluntary isometric force. Functional measures included: Knee Osteoarthritis Outcomes Survey (KOOS) subscales: Pain, Sports and Recreation (SR), and Activities of Daily Living (ADL); the Global Assessment of Knee Function (GLOBAL); Knee Outcome Score - Activities of Daily Living Scale; and a timed stair climb test. Variables from the force pulses included: peak RFDb and time to peak RFDb; peak force and time to peak force, half-relaxation time. Mean and standard deviations of the force variables were computed across 2 groups of trials: Those above 50% MVIC and those at or below 50% MVIC. Independent Samples t tests and repeated measures ANOVA assessed group differences. Correlation coefficients and hierarchical regressions were used to assess relationships.

RESULTS: OA subjects were weaker than controls (P = .015) and were slower when walking at a selfselected speed (P = .002) or fast speed (P = .002), and they performed the stair climbing test more slowly (P = .000). With respect to the force pulses, variables were generally greater for the high versus the low force pulses in time to peak force (main effect, P = .000) variability of time to peak force (main effect P = .000) and half relaxation time (main effect, P = .009). Main effect group differences revealed that OA subjects had slower (P = .065) and more variable (P = .022) time to peak force, and their half relaxation times were also slower (P = .001). No interaction effects were observed in any of the variables. In the OA subjects, time to peak force correlated negatively with free (r = .408, P = .048) and fast (r = .537, P = .007), but not in the controls. After accounting for the influence of strength, time to peak force across all force pulses explained 11% and 13% more of the variance in the stair climbing time in controls (P = .001) and OA subjects (P = .001), respectively.

CONCLUSIONS: The results support our hypotheses that people with knee OA generate force more slowly than controls of similar age and the faster the time to generate peak force in the quadriceps relates to higher function in both groups.

CLINICAL RELEVANCE: It is well known that strong quadriceps relate to higher function in people with knee OA, but time to peak quadriceps force was also an important factor in maintaining high function. The findings should be considered when developing treatment plans for patients with knee OA.

OPO237

RECOGNITION AND TREATMENT OF YELLOW FLAGS IMPROVE OUTCOMES IN A PATIENT WITH CHRONIC LOW BACK PAIN: A THERAPEUTIC NEUROSCIENCE EDUCATION APPROACH

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BACKGROUND AND PURPOSE: Recent literature discusses the importance of recognizing patient modifiable risk factors (yellow flags) such as fear avoidance and catastrophizing and how these risk factors affect patients with chronic low back pain (CLBP). Therapeutic neuroscience education (TNE) has been shown to decrease pain and improve function in patients with chronic pain. When patients with CLBP present with yellow flags, they may not receive maximal benefit from traditional physical therapy. This case study illustrates the use of TNE to improve function by decreasing fear avoidance and catastrophizing in a patient with CLBP.

CASE DESCRIPTION: Patient is a 31-year-old woman diagnosed with lumbar radicular pain. The patient has a history of motor vehicle accident (MVA) 15 months prior to her initial evaluation (IE) at this facility. Following the MVA, the patient received physical therapy at another facility with some benefit. However, CLBP limited the patient’s work and functional activity. Prior to IE, patient was referred for microdiscectomy, but preferred to pursue conservative options and declined surgery. At IE, patient demonstrated high levels of pain and functional limitation: numeric pain rating scale (NPRS) of 7/10, Oswestry disability score (ODS) of 54%, lumbar extension of 10° with pain and StArT Back Tool (StArT): high risk rating. At IE, mechanical diagnosis and treatment (MDT) was attempted, however, the patient was unable to perform repeated extensions. TNE was then provided and following discussion, patient was then able to perform repeated movements. Both were given for HEP. The patient was seen by 1 physical therapist for 13 visits over a period of 8 weeks. Intervention included TNE in every session as well as MDT, core stabilization and progressive functional strengthening.

OUTCOMES: Outcome measures were assessed on a weekly to bi-weekly basis. Significant change was noted in week 5 following the seventh session, when the patient reported NPRS of 3/10, ODS of 28%, and the therapist measured lumbar extension of 70° without pain. Patient was re-categorized to medium risk per the StArT, suggesting positive change to modifiable risk factors. At visit 13, patient maintained improvement with NPRS of 2/10, ODS of 32%, lumbar extension of 70° without pain and medium risk category per StArT.

DISCUSSION: This case study illustrates the importance of recognizing and addressing yellow flags in a patient with CLBP. The addition of TNE to
a traditional physical therapy plan is thought to have helped decrease the patient's modifiable risk factors, thereby facilitating a decrease in the patient's pain level and improvement in their function. Further investigation is needed to determine the effectiveness of TNE implementation in patients who present with yellow flags and the implications for rehabilitation.

**OP0238**

**IDENTIFICATION OF PERIPHERAL ARTERIAL DISEASE IN A PATIENT REFERRED FOR LUMBAR RADICULOPATHY IN AN OUTPATIENT ORTHOPAEDIC CLINIC**

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**BACKGROUND AND PURPOSE:** Demonstrate how primary PT can effectively triage a patient over the course of care by describing a patient referred with gluteal pain, a diagnosis of lumbar radiculopathy and a complex PMH.

**CASE DESCRIPTION:** A 63-year-old man with 9-month history of buttocks pain with walking. No pain below gluteal folds. Distance limited to 200yds. Full resolution of pain within 1 minute of rest. PMH includes diabetes mellitus (II), hypercholesterolemia, 30 pack-year smoking history, 7 cardiac stent placements (2012), LE angioplasties (2013, 2014), L femoral stent (2015). Had negative work-up with vascular 4 months prior to PT exam. PCP then referred to physiatry. MRI/X-rays: positive L5 nerve root irritation. Referred to PT. He is an administrator requiring prolonged desk work. Since last surgery he has been extremely sedentary. No regular exercise. Most activity occurs when walking to pro soccer stadium 12 times per yr. Goal is to improve tolerance to walking so he can go to games with his son. PT exam: NPRS: rest 0/10, worst 9/10; ODI 20; SF36 10. Initial: minimal hip extension, slow, short strides. Lumbar AROM/repeated motions: WNL, pain free. Two Stage Treadmill Test (TSTT): negative for stenosis, onset of pain earlier when walking at grade. PROM B hip extension: 15°. Lumbar mobility: Reduced LA-5. Muscle length deficits: hip flexors and hamstrings. MMT: hip abduction and extension 3+/4. Initial diagnosis: Non-specific LBP due to deconditioning with differential including PAD. Initiated strength/endurance program. At 3 weeks, onset of L thigh pain with walking more than 4 minutes. At 4 weeks, onset of R calf pain with stairs. Re-eval: NPRS: 0/10; ODI: 14; PSFS: 0/10. Repeated TSTT: onset sooner at grade and 1 minute earlier than at exam. Due to minimal progress, PMH and negative lumbar testing, exercise ABI completed as pain occurs with walking and perfusion tests with exertion had not been performed. ABI: resting = 0.89, ABI postexertion = 0.41.

**OUTCOMES:** Patient was referred to vascular and recommended exercise ABI. Provided a PAD-specific walking program. Emails over next 8 weeks revealed no change or compliance with HEP. Repeat vascular consult: resting ABI only (normal). PT strongly encouraged patient to return and advocate for exercise ABI. Three weeks later vascular testing performed postwalking and identified severe blockages in legs with possible blockage in aortoiliac artery.

**DISCUSSION:** In reflection, despite findings of modifiable impairments related to LBP, failure to perform vascular testing and relying on MD recommendations may have prolonged patient's discomfort. Once identified, consistent contact with and advocacy for the patient finally led to correct diagnosis. PTs with Residency and Fellowship training are capable of identifying nonmusculoskeletal disorders and make appropriate referrals. Identification of failure to improve, confidence with lumbar exam and considering functional deficits when utilizing vascular testing aided the decision in this case.


**OP0239**

**THE EFFECTIVENESS OF PHYSICAL THERAPY INTERVENTIONS TARGETING THE SHOULDER GIRDLE IN ADULTS WITH SHOULDER PAIN: A SYSTEMATIC REVIEW**

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**PURPOSE/HYPOTHESIS:** The objective of this study was to systematically review the literature available to determine the effectiveness of physical therapy interventions that address impairments associated with the shoulder girdle in adults with shoulder pain.

**NUMBER OF SUBJECTS:** Twenty studies were analyzed.

**MATERIALS/METHODS:** A systematic literature review was performed using The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines through database searches of PubMed, PEDro, CINAHL, MEDLINE, Cochrane and SPORTdiscus. Search terms included subacromial impingement syndrome (SAIS); rotator cuff; scapula and scapular dyskinesia/dyskinesis; combined with dynamic mobility; proprioceptive neuromuscular facilitation (PNF); Kinesio Taping; stabilization; scapular mobilization; strength or scapular focused intervention. Studies were included if they were published from 2007 to 2017, had adult human participants with a defined shoulder pathology or shoulder pain, physical therapy interventions were used to improve the scapular position and movement, and had at least 1 outcome measure that assessed the scapular position or movement directly or indirectly. The study quality was appraised by 2 blinded reviewers using the Physiotherapy Evidence Database (PEDro) scale.

**RESULTS:** A total of 20 randomized controlled trials (RCT) were appraised. All of the studies included had high quality with an average PEDro score of 8/10. The majority of the studies (17/20) in this review performed interventions on subjects with SAIS. The studies that focused on strengthening exercises of the shoulder girdle demonstrated significant differences between groups (P<.05) for ROM, pain and level of disability for patients with SAIS in 4 of the 5 studies analyzed. Of the 2 studies that focused on stabilization exercises one measured a significant difference (P<.05) in shoulder ROM, pain and strength and the other measured improvements in pain, scapular/shoulder ROM as well as improved scapular posture. The 5 studies using scapular taping, the 4 that focused on PNF and the 4 utilizing scapular mobilizations showed inconsistent improvements in pain, disability, strength and shoulder ROM.
CONCLUSIONS: There are a variety of interventions examined in the literature that focus on impairments of the shoulder girdle in adults with shoulder pain. The consensus of the current research suggests that strengthening and stabilization exercises demonstrate the most consistent improvements in ROM, strength and function in patients with SAIS. The mode of strengthening and muscles targeted were not homogeneous in the literature and future research is recommended to determine the optimal combination for this population.

CLINICAL RELEVANCE: This study revealed strong evidence that strengthening and stabilization exercises targeting the deltoid, rotator cuff and periscapular musculature can increase shoulder ROM and decrease pain and disability for patients with SAIS.

END-STAGE HALLUX RIGIDUS REQUIRING CHEILECTOMY IN A 24-YEAR-OLD PATIENT

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BACKGROUND AND PURPOSE: Hallux rigidus is a condition characterized by significant stiffness of the great toe, especially with great toe dorsiflexion. Only hallux valgus is more prevalent in patients with great toe pain.

METHODS: Impairments associated with hallux rigidus include pain, loss of motion and strength of the great toe, and altered gait mechanics. It is more common in females and people over 40 years of age, with mean age of onset of 49 years. Conservative and surgical treatment options exist for the treatment of hallux rigidus. If conservative treatment fails, cheilectomy is a surgical technique that can be utilized to improve first metatarsophalangeal (MTP) joint ROM. This procedure consists of partial resection of the superior aspect of the first metatarsal head and of the base of the first phalanx. There is a lack of research on the effects of cheilectomy in the young adult population. The current case study was compiled to describe one such case of a 24-year-old who required surgical intervention.

CASE DESCRIPTION: The current case is a 24-year-old female physical therapist assistant with a progressive history of first MTP joint pain. No specific trauma was identified, but she reports that the pain may have started during high school cheerleading. She noted a history of her joint getting “stuck” in first MTP dorsiflexion which made ambulation painful. Self-manipulation of the great toe would allow her to return to ambulation. Exercises and injections were unsuccessful in alleviating her symptoms. She underwent cheilectomy and bunionectomy of the first MTP joint, osteotomies of both the first and second metatarsal-cuneiform joints, and decompression of the peroneal nerve. She was referred to physical therapy 3 weeks after surgery to regain range of motion and strength in the right foot, improve weight bearing, and to normalize ambulation. Treatment initially consisted of manual therapy including PROM and dorsal/ventral foot, improve weight bearing, and to normalize ambulation.

OUTCOMES: The patient was able to improve range of motion to 60° active first MTP joint dorsiflexion and 70° of passive dorsiflexion over the 8 weeks of physical therapy. She also was able to demonstrate full weight bearing and normalized ambulation without pain at the time of her discharge from physical therapy. She returned to running and all other functional activities without pain in her right foot.

DISCUSSION: Cheilectomy and physical therapy was sufficient to restore first MTP motion and normal function in this patient. However, further research needs to be done in order to determine the long-term effects of surgical management versus conservative treatment of first MTP joint arthritis in young adults.

OPO243

MODIFIABLE IMPAIRMENTS IDENTIFIED YEARS AFTER SURGICAL INTERVENTION FOR ARNOLD CHIARI MALFORMATION: RESPOND TO PHYSICAL THERAPY INTERVENTION

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BACKGROUND AND PURPOSE: Arnold Chiari malformations describes the brain stem, cerebellum or upper spinal cord herniating through the foramen magnum. Patients may be managed with surgical decompression, however symptoms can persist. This case report describes the impact of interventions on measurable cervical impairments observed long after surgical management for Arnold Chiari Malformation.

CASE DESCRIPTION: A 20-year-old woman; acute on chronic exacerbation of cervicalgia and headaches. Last large episode 2 years ago, last 8 months; smaller episodes 1 to 2 times per month. Medical history: upper cervical decompression after Arnold Chiari Malformation diagnosis 8 years prior to PT eval. Subjective: Exacerbation after prolonged microscepe use at school. Pain (current 4/10; best 0/10, worst 8/10); area: suboccipital headaches that then spreads to anterior cervical, mid clavicular and mid-thoracic regions; frequency: 4 to 5 times per /week; duration: 1 to 4 hours. Alleviating factors: medication; moist heat. Aggravating factors: school work, microscope use, driving. Goals: complete all aggravating factors without symptoms. Objective: Patient-Specific Functional Scale (PSFS 0 (unable) to 10 (fully able)); studying 5, microscope use at school. Pain (current 4/10; best 0/10, worst 3/10). Objective - PSFS: all 10/10; NDI: 4%; FABQ: PA 3/24, W 6/42; global rating of change: very great deal better (+7); Cervical AROM, palpation: all pain free; joint mobility: normal; CFET: 8 mmHg; 10 reps; NEET test: 75 seconds; Cervical Joint Position Error Test: 4/9 errors; Scapular MMT: all 4/5 B.

DISCUSSION: Cervical impairments may persist years after surgical intervention for Arnold Chiari Malformation. An impairment based model and matched interventions can assist these patients with managing an acute on chronic exacerbation of neck pain and headaches while improving overall function.


OPO243

ACUTE AND LONG-TERM CHANGES IN ACROMIOHUMERAL DISTANCE FOLLOWING A FATIGUE PROTOCOL AND A 6-WEEK EXERCISE PROGRAM

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PURPOSE/HYPOTHESIS: Deficient muscle force may lead to glenohumeral (GH) superior migration reducing the subacromial space. A few studies have reported conflicting findings in glenohumeral migration with fatigue in healthy adults using radiography2 and ultrasound (US).1 Limited evidence exists on the effect of exercise on the AHD.4 To our knowledge, no study has examined changes in AHD with a FP following a course of exercise. The purpose of this study to examine changes in AHD following a 6-week exercise program before and immediately after fatigue.

NUMBER OF SUBJECTS: Nineteen (mean ± SD age, 25.4 ± 5.0 years; 8 male, 11 female) asymptomatic, sedentary.

MATERIALS/METHODS: AHD (linear distance between the acromion and humerus3), was measured on the dominant arm using US6, in 3 conditions: arm by side, at 45°, at 45° with a 5-lb weight in the hand (45 W) before and immediately after a FP. The FP was completed in prone with arm supported at 90° of abduction. Maximum external rotation (ER) force was ob-

RESULTS: There was a statistically significant relationship between the presence of night pain and percent fat in the subscapularis \((P = .044)\). Patients with night pain had greater fat infiltration (mean diff, 3.6%; 95% CI: 0.1%, 7.2%). While there were trends of a moderate negative linear correlation \((P = .065, r = -0.52)\) between numeric pain rating and percent fat in the infra/teres minor, but this did not reach statistical significance. There were no other significant relationships between pain and fat infiltration \((P > .05)\). With regard to function, there were no significant differences in percent fat between patients with RC disease who reported limited function with overhead activities and patients who did not \((P > .05)\).

CONCLUSIONS: Patients with night pain presented with greater fat infiltration in the subscapularis muscle. The differences were small, but exceeded the MDC for this measure.

CLINICAL RELEVANCE: Preliminary findings suggest that fat infiltration is not correlated with pain and function with the exception of potential subscapularis intramuscular changes. It is unknown whether greater fat infiltration in the subscapularis is a result or cause of greater night pain. Further study with larger samples are needed.
OP0246

PERCEIVED IMPACT OF ORTHOPAEDIC MANUAL THERAPY FELLOWSHIP ON PROFESSIONAL ATTRIBUTES AND INVOLVEMENT: A SURVEY STUDY
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PURPOSE/HYPOTHESIS: To describe graduate perceptions of the impact of fellowship training (FT) on professional attributes and involvement.

NUMBER OF SUBJECTS: Seventy-five graduates of a credentialed, hybrid learning, multisite fellowship program.

MATERIALS/METHODS: Graduates were administered an online survey investigating the impact of FT on various clinical skills, income, and professional attributes and involvement. In the area of professional attributes and involvement, respondents rated the impact of FT on an 11-point Likert scale (1 is “Significant Negative Influence,” 6 is “No Influence,” 11 is “Significant Positive Influence”). Frequency analyses and descriptive statistics were performed.

RESULTS: Seventy-five (97%) of 77 graduates completed the survey. They rated the impact of FT on self-perception as a professional at 10.7 ± 0.7. While in the program, all fellows-in-training (FiTs) were required to be members of the American Physical Therapy Association (APTA) and the American Academy of Orthopaedic and Manual Physical Therapy (AAOMPT), and at the time of the survey 90% (n = 72) of graduates continue to be a member of the APTA/AAOMPT where 22.7% (n = 17) have held official positions within these organizations (board member or committee member). Twenty-four percent (n = 19) of graduates have served within their state chapter or district as a state delegate, board member or committee member. One hundred percent (n = 75) of graduates obtained board certification in Orthopaedics (OCS) while FiTs, 96% (n = 72) continue to have the OCS credential. This is contrasted to only 59% (n = 44) having the OCS credential prior to FT. 80% (n = 60) of graduates are involved in professional activities related to teaching in professional and postprofessional education. Furthermore, 89% (n = 67) of graduates reported involvement as clinical mentors for: peers in clinical practice, DPT students (from 65 programs), residents (from 23 credentialed programs), and/or FiTs (9 credentialed programs). Seventy percent (n = 53) stated that their fellowship experience had “significant positive influence” on their confidence in teaching and mentoring. Professional aspirations over the next 5 years included the following: 53% (n = 40) plan to obtain a terminal doctoral degree (DSc, PhD), over 60% wish to teach in entry level physical therapy education programs, 63% (n = 47) want to expand their involvement in professional organizations (APTA, AAOMPT) and over 57% (n = 43) desire to contribute to clinical research.

CONCLUSIONS: Graduate perceptions of the impact of their training on professional involvement were overwhelmingly positive. Graduates reported substantial involvement in professional organizations, professional and postprofessional education, and clinical mentorship.

CLINICAL RELEVANCE: Fellowship training provides an opportunity for clinicians to enhance their professional attributes and involvement that includes involvement within professional organizations as well as professional mentorship. This engagement can enhance advocacy efforts as well as supplement the paucity of qualified faculty needed for orthopaedic residency and fellowship programs, as well as DPT programs.

OP0247

BENEFITS OF PREHABILITATION ON FUNCTIONAL OUTCOMES IN TOTAL KNEE ARTHROPLASTY PATIENTS: A SYSTEMATIC REVIEW
Ryan Shotts, Cody Lancaster, Matt Dew, J.P. Phillips,
OP249

SHORT- AND LONG-TERM OUTCOMES FOR A PATIENT WITH MIDSUBSTANCE ACHILLES TENDINOSIS MANAGED WITH ASTYM AND EXERCISE

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BACKGROUND AND PURPOSE: The symptoms from Achilles tendinopathy can be variable depending on the duration and the location of the insult to the tendon. When symptoms of pain and reduced motion and/or strength have persisted for greater than 3 months, it is considered that they are a result of degenerative changes within the tendon, and the term tendinosis is frequently used. One management option, whether for insertional or midsubstance Achilles tendinosis, is the use of eccentric exercises. However, limitations of eccentric exercise are that the exercise regime can be painful and the expected results can take up to 12 weeks. An alternative to the eccentric protocol is the use of Astym where patients are applied to locate unhealthy soft tissue and transfer mild to moderate pressure to the underlying soft tissue structures. The purpose of this case report is to provide a detailed account of the response of a patient to a course of Astym and exercise and the patient's continued outcome at 52 weeks following her initial referral to physical therapy (PT).

CASE DESCRIPTION: The patient was a 46-year-old woman who reported the onset of left Achilles pain 4 months prior to attending PT. The patient recalled that prior to the onset of her symptoms she had increased her weekly cardio workouts. At the time of the evaluation, the patient was working as an engineering manager which entailed sitting over 75% of her day. The patient reported pain in her left Achilles with descending stairs and that she was unable to raise up on her left toes or walk more than 20 minutes due to the pain. Her numeric pain-rating scale (NPRS) was 5/10 and Victorian Institute of Sport Assessment-Achilles (VISA-A) score was 20/100. There was notable fibrosis detected in the gastrocnemius and Achilles tendon when assessed with the Astym tools. The patient underwent 6 weeks of twice a week PT which consisted of Astym, stretches of the gastrocnemius and soleus muscles, and a progressive resistive exercise program of heel raises (concentric control), progressive resistance Thera band walks, squats, and step-ups.

OUTCOMES: Over the 6 weeks the patient’s NPRS and VISA-A score were recorded weekly with a progressive trend toward reduced pain and increased function. At the end of 6 weeks her NPRS was 2/10 and her VISA-A score was 42%. These outcomes were tracked again at 12 weeks where she scored 1/10 on her NPRS and 69% on her VISA-A. The final outcomes were recorded at 52 weeks where she scored 0/10 on the NPRS and 71% on the VISA-A.

DISCUSSION: This patient responded positively to 6 weeks of Astym and exercise with a progressive reduction of pain and increase of function as measured by the VISA-A. This contrasts to published reports of patient response to eccentric exercise where the pain frequently increases initially. The patient continued to improve beyond her time in PT with reductions of pain and improvements in function at 12 and 52 weeks. A combination of Astym and exercise is another possible option for management of this condition.


OP250

THE VALIDITY AND RELIABILITY OF A SMARTPHONE APPLICATION FOR MEASURING RANGE OF MOTION IN ALL PLANES

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PURPOSE/HYPOTHESIS: The use of smartphone applications for goniometry is becoming increasingly popular amongst physical therapists due to its accessibility, ease of use, and affordability. While the literature regarding the validity and reliability of these applications is increasing, there remains a lack of evidence supporting the use of these applications in providing accurate measurements. Previous research of the “Goniometer” application for the iPhone 6s iOS found it to be reliable and valid in the gravity dependent plane (sagittal/frontal), however it was not reliable and not valid in measuring fixed angles in the transverse plane due to the instrument’s inability to maintain a stable true north. The purpose of this study was to test the reliability and validity of the RateFast goniometer application for the iPhone compared to the gold standard goniometer for measurements in all planes, including the transverse plane. We hypothesize that the RateFast goniometer application for the iPhone will be as valid and reliable as the goniometer for all planes of measurement.

NUMBER OF SUBJECTS: Four raters each measuring 30 angles in 2 positions.

MATERIALS/METHODS: Four Doctor of Physical Therapy students acted as raters to measure 30 randomly selected angles generated by using a protractor wedge in whiteboard software which were then verified via a “gold standard” steel protractor. (16 angles were less than 90°, 14 angles were greater than or equal to 90°) The raters measured the 30 angles in both the gravity dependent (sagittal/frontal) and transverse planes using the RateFast goniometer application for the iPhone. Measurements were repeated 5 days later with the same angles placed in a new randomized order. We calculated...
the intraclass correlation coefficients (ICCs) for intrater and interter reliability and the absolute value (AV) of the difference between the actual and measured angles and across repetitions for validity.

RESULTS: In both the gravity dependent and transverse trials the ICCs (95% CI) for all 4 raters demonstrated excellent intrater and interter reliability (0.99-1.0 in all planes and raters). Across all raters and trials the mean difference between the application measurement and the actual angle ranged from 0.13° to 1.58°.

CONCLUSIONS: The RateFast goniometer application for the iPhone was found to be valid and reliable in measuring fixed angles in all planes, including the transverse plane.

CLINICAL RELEVANCE: The results of this study indicate that the specific software and device tested is valid and reliable for measuring fixed angles in all planes. Further research is needed to determine the validity and reliability of the application for use on human subjects.

OP0251

THE USE OF MUSCULOSKELETAL ULTRASOUND IN THORACIC OUTLET SYNDROME AS IT RELATES TO MUSCULAR ATROPHY AND VASCULAR IMPAIRMENTS: A CASE REPORT

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BACKGROUND AND PURPOSE: In patients with TOS, neurovascular structures become compressed as they exit the neck and enter the upper limb. The compression that results can be overlooked creating ambiguity regarding proper diagnosis and management. US imaging has become popular in the field of musculoskeletal medicine and could be fundamental to improving physical therapy (PT) outcomes in this population. Presented is a unique case of muscle atrophy and decreased arterial perfusion as a result of TOS in which we were able to use US to assess the neurovascular function before, during, and after TOS special tests and measure the girth of the rotator cuff and trapezius muscles. The objective of this study is to provide a clinical outlook on using US as a tool to objectively assess patients in PT.

CASE DESCRIPTION: A 38-year-old man with bilateral vascular TOS had a chief complaint of left upper extremity (UE) swelling and pain (6/10). Surgical interventions have included thrombolysis procedures on the rib (1999), a left partial first rib resection (2010), and left subclavian-carotid bypass graft (2011). At 1-year follow-up patient reports that he is able to manage his symptoms if he attends to correcting movement impairments during performance of daily activities.

OUTCOMES: The upper (UT), middle (MT), and lower trapezius (LT), supraspinatus (SS), infraspinatus (IS), and subscapularis (SB) were assessed for strength using MMT and girth using US. The patient presented with decreased strength in the LT (4+/5), IS (4+/5), and SS (4/5) on the left side as compared to the right, which all presented as (5/5). Girth measurements are listed below (right, left): UT: 0.49 cm, 0.33 cm; MT: 0.46 cm, 0.44 cm; LT: 0.45 cm, 0.41 cm; SS: 1.30 cm, 1.12 cm; IS: 1.56 cm, 1.25 cm; SB: 0.70 cm, 0.69 cm. The following special tests were performed: Adson’s, Allen’s and Costoclavicular special tests 2 with negative results bilaterally. The Brachial Plexus Compression test and upper limb tension tests (ULTT) for the radial and median nerves were positive bilaterally. ULTT for the ulnar nerve showed positive results on the left and negative on the right. US imaging was used to assess the subclavian artery’s area before, during, and after each special test. Results are listed below (pre, during, post): Allen’s Test: R: 0.29 cm², 0.47 cm², 0.34 cm²; L: 0.39 cm², 0.37 cm², 0.41 cm². Costoclavicular Test: R: 0.29 cm², 0.40 cm², 0.36 cm²; L: 0.39 cm², 0.31 cm², 0.32 cm². Adson’s: R: 0.29 cm², 0.16 cm², 0.36 cm²; L: 0.39 cm², 0.32 cm², 0.27 cm².

DISCUSSION: Deficits in strength using MMT correlated with findings of decreased girth using US. The patient presented with negative vascular compression tests bilaterally, however, the US showed decreased area of the blood vessel in the left UE. These results lead us to conclude that US is a useful tool in patients with neurovascular compromise due to TOS and can be implemented in a clinical setting for collecting objective data regarding patients’ impairments.


OP0252

DIAGNOSIS AND TREATMENT OF A PATIENT WITH CHRONIC POSTERIOR CHEST WALL PAIN

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BACKGROUND AND PURPOSE: Diagnosing and treating patient complaints of posterior chest wall (PCW) pain can be difficult. Rib joint dysfunction has been noted to be a contributor to PCW pain and if untreated can become chronic in 87% of patients. Associated regions need to be considered in the management of chronic PCW pain including alignment and movement of the thoracic spine and scapulothoracic joint. The purpose of this case report is to describe a systematic movement exam of a patient with a 2-year history of PCW pain, and to describe the outcomes and treatment with an emphasis on improving specific joint function and movement impairments of the thoracic spine and scapulothoracic joint.

CASE DESCRIPTION: A 31-year-old man reported a 2-year history of constant left PCW and left shoulder pain after a fall from his bike. Previous medical and physical therapy interventions had been unsuccessful. Evaluation of standing alignment revealed a swayback posture with scapulae in a position of excessive internal rotation (IR) and anterior tilt (AT). He presented with limited motion and pain in the PCW with active thoracic extension, left rotation, left side bend and end range left shoulder flexion. Passive mobility testing and palpation revealed prominence and pain along the rib joints of 6 and 7. Active exercise and functional instruction were attempted but the patient’s PCW pain was too intense. A thrust manipulation was applied to the rib joints 6 and 7 followed by taping to support the rib position. The patient reported an immediate reduction in PCW symptoms (3/10 to 0/10). The patient was assigned a movement diagnosis of Thoracic Flexion Rotation and Scapular Internal Rotation and Anterior Tilt. Treatment included instruction and practice of daily postures and work activities that emphasized recruitment of thoracic paraspinals to minimize thoracic flexion, recruitment of scapular adductors to minimize excessive scapular IR and AT throughout the day resulting in decreased pain at the end of the workday.

OUTCOMES: The patient was seen for 10 visits over 14 weeks. At the final visit the patient reported: best pain 0/10 (initial 3/10) and worst pain 4/10 (initial 7/10). QuickDASH: 15.90% (initial 36.36%); work score 12.5% (initial 37.5%), sport score 25% (initial 100%). AROM of the shoulder was nonpainful in the PCW. He was able to return to rock-climbing. At 1-year follow-up patient reports that he is able to manage his symptoms if he attends to correcting movement impairments during performance of daily activities.
DISCUSSION: Consideration of rib joint position and function as well as associated regions is important to consider when managing chronic PCW pain. Movement impairments and altered movement strategies during daily activities could be a contributor to the persistence of chronic PCW pain. This patient demonstrated the importance of first addressing rib joint dysfunction, which then improved his ability to correct the movement impairments of thoracic flexion rotation and scapular IR and AT during his work and functional activities.


OP0253

SERIAL ASSESSMENTS OF OUTCOME MEASURES SHOW CHANGE AND HELP JUSTIFY K3 COMPONENTY IN A PATIENT WITH BILATERAL AMPUTATIONS

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BACKGROUND AND PURPOSE: For prosthetic reimbursement, self-report and performance measures need to be included in documentation to warrant physical therapy (PT) and to justify functional level classification for prosthetic componentry. There is limited research data among adults with bilateral amputations and comparisons to adults with unilateral amputations may be problematic. This case study shows the value of serial testing of a patient with bilateral lower-limb amputations to track changes in function over time and to provide data to justify recommending higher level prosthetic components.

CASE DESCRIPTION: The patient is a 56-year-old man with a recent right transfemoral amputation and left transfemoral amputation of 3 years. A total of 10 data collections were performed over the course of 2 years, including an evaluation with an initial K2 hydraulic knee and an evaluation 2 years later when the patient was evaluated for an upgrade to a K3 microprocessor knee. Outcome measures included the Timed Up and Go (TUG), L-Test, 10 Meter Walk Test (10MWT), Amputee Mobility Predictor-Bilateral (AMP-B), and Activities Balance Confidence Scale (ABC).

OUTCOMES: The TUG with the K2 knee improved from 44 seconds to 24 seconds over the course of 8 months of PT. When retested with a K3 knee, TUG score was 17 seconds, which is faster than the 23 seconds reported for adults with a unilateral transtibial amputation. Similarly the L-test with the K2 knee and PT improved from 73 to 48 seconds, and improved to 38 seconds with a K3 knee. Gait speeds on the 10MWT were similar with both the K2 and K3 knees. AMP-B varied between 30 and 38/47 across testing placing the patient at the K2 functional level, when compared to data from adults with an unilateral lower-limb amputation. The ABC increased from 40% to 48% with the K2 knee and PT and to 74% with a K3 knee.

DISCUSSION: PT may help to improve some functional measures but when a patient is limited by the device's componentry, the patient may not maximize their mobility potential. For example, while the TUG and L-Test improved with PT using a K2 knee, further gains were made when a K3 knee was used by this patient. There was a large increase in ABC, which reflects a significant improvement in balance-confidence, which is important as balance-confidence is associated with physical activity levels and predictive of prosthetic nonuse at follow-up. Importantly, the Centers for Medicare and Medicaid Services states bilateral amputees often cannot be strictly bound by functional level classifications, so higher-level components may be reimbursed if medically-necessary with supporting documentation. Serial objective performance-based data in such cases may enhance documentation for higher-level prosthetic componentry that may significantly improve functional outcomes.


OP0254

NONSPECIFIC EFFECTS OF MANUAL THERAPY: A MIXED-METHODS INVESTIGATION OF CONTEXTUAL AND SOCIAL INTERACTIONS

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PURPOSE/HYPOTHESIS: Despite the high-level of evidence supporting the use of manual therapy (MT), the specific mechanisms of action remain elusive. In addition to biomechanical and neurophysiologic effects, psychological effects such as patient alliance, expectation, and contextual factors may impact the efficacy of MT. Previous studies indicate improved outcomes following manipulation or sham interventions involving the thoracic spine. This study examines the contextual and social factors related to upper quarter neurodynamic mobility improvement following a sham intervention.

NUMBER OF SUBJECTS: Twenty-four subjects (48 limbs).

MATERIALS/METHODS: Twenty-four adults were randomized into 8 groups with combinations of 3 conditions (vague/detailed explanation, therapist gender match/mismatch, therapist wearing labcoat/no labcoat) and tested for the presence of neurodynamic limitation via the Upper Limb Provocation Test (ULPT). Subjects with neurodynamic limitations (n = 22) in at least 1 limb (n = 46) received a sham thoracic spine manipulation, and ULPT was reassessed. The subject-therapist interaction was
videotaped and analyzed. Subjects also completed a semi-structured interview about their experience. Data from video analyses and interviews were triangulated to identify themes and develop a concept map.

RESULTS: Forty-six limbs presented with neurodynamic limitations. Significant improvement was demonstrated in ULPT following sham thoracic spine manipulation (P<.05). Although not statistically significant due to the high proportion of successful outcomes (75%), trends were noted. Specifically, subjects who received a sham intervention from a clinician of the opposite gender, wearing a labcoat, or who provided a descriptive explanation improved to a greater extent than the alternative conditions (9.1°, 4.6°, 3.6°, respectively). The following 3 themes emerged as influential factors in subject-clinician interaction: (1) professionalism, (2) communication, and (3) expectation. A detailed explanation positively influenced expectation in 90% of interactions. Conversely, those who received a vague explanation reported no expectation in 90% of interactions. Duration of interaction approached significance (P = .08) for those who had a positive response to the sham intervention.

CONCLUSIONS: Improved neurodynamic mobility following a sham thoracic spine manipulation is consistent with previous studies and outcomes of pain and disability following a sham. Patient perspectives indicate that social and contextual features of professionalism such as dress, communication, and explanation can influence expectation, and perhaps, partially account for the effect of MT techniques.

CLINICAL RELEVANCE: Awareness of nonspecific responses to MT such as expectation may enhance the positive effects of intervention. Depth of explanation, the quality, and quantity of our interactions may influence expectation and should be considered by therapists providing MT interventions. Positive expectation may be additionally reinforced by strong interpersonal skills and professional dress.

OP0255

IS THERE A NEED FOR ROUTINE FALL-RISK SCREENING IN THE OUTPATIENT PHYSICAL THERAPY SETTING?  
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PURPOSE/HYPOTHESIS: Medicare guidelines mandate that patients over 65 years be screened for fall risk if they have a significant fall history (1 fall with injury or 2 falls without injury in 1 year). The current study investigates whether these guidelines should be expanded to better identify individuals with musculoskeletal injuries who have undetected balance impairments and are being treated in an outpatient setting.

NUMBER OF SUBJECTS: Twenty-three subjects who were being treated for musculoskeletal injuries in an outpatient setting were recruited for this study (12 male, 11 female). All participants were within their first 3 physical therapy visits. Data were collected once. Exclusion criteria included: a history of falls, diagnosed neurological issues, known balance issues, polypharmacy (greater than 6 medications), cognitive deficits, and inability to follow instructions. Touro IRB approval was obtained. All subjects signed a written informed consent.

MATERIALS/METHODS: The following valid and reliable tests were used to determine fall risk: The Brief BESTest, 360° Turn, Four Square Step Test (FSST), Tandem Stance and Single Leg Stance (SLS). Data were analyzed using SPSS version 20. Materials required for completing these tests were: 4-inch foam pad, stopwatch, yardstick and a stable chair.

RESULTS: Twelve of the 23 subjects (52%) were found to be at fall risk on 1 or more of the balance tests 8 subjects (75%) of those identified were under the age of 65 years. All 4 of the subjects who over 65 years were found to be at fall risk (100% of 65+ pool) Only 2 individuals fell below the cutoff score for the Brief BESTest The 360° turn test and SLS tests were most effective at identifying subjects at risk of falls (9 subjects and 6 subjects, respectively) The 360° turn test and SLS test combined were able to identify all 12 of the subjects who were determined to have balance im-

CONCLUSIONS: Of the 12 subjects found to be at fall risk, 100% of those identified would not have been identified under the present guidelines for fall risk assessment. The 4 subjects over 65 years did not report any falls in the past year and so were not screened for fall risk, as per Medicare guidelines.

CLINICAL RELEVANCE: Based on the findings of the current study, there is some indication for expanding the guidelines for fall screening of patients in the outpatient physical therapy setting. This may help to identify individuals as having significant fall risk although they are under 65 years old and/or have no history of falls. Results suggest the 360° turn test and SLS test are efficient tools that can assess static and dynamic balance impairments.

OP0256

TREATMENT OF SHOULDER PATHOLOGIES BASED ON IRRITABILITY: A CASE SERIES  
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BACKGROUND AND PURPOSE: Shoulder pain is a prevalent issue in health care. Traditional treatment of shoulder pain is based on a pathoanatomical medical model aimed at determining specific damage to anatomical structures through the use of special tests. The validity of such special tests is questionable and this approach does not take into consideration patients with similar diagnoses who have varying prognoses and courses of treatment. Minimal evidence exists for use of an irritability model to guide treatment in individuals with varying shoulder diagnoses. The purpose of this case series is to apply the principles of irritability, proposed in the Staged Approach Rehabilitation Classification, to patients with varying anatomical diagnoses.

CASE DESCRIPTION: Three patients clinically diagnosed with different shoulder pathologies were recruited from a physical therapy clinic in Acworth, Georgia. Diagnoses included unspecified disorder of synovium and tendon, adhesive capsulitis, and other shoulder lesions. All 3 patients were assessed using an operational definition for classifying patients based on stages of irritability, and were classified as moderate irritability. Patients received treatment based on impairments and irritability.

OUTCOMES: Patients were treated for a total of 14 to 18 visits over a course of 7 to 8 weeks. Pain measured by the numeric pain rating scale and disabilities measured by FOTO (Focus on Therapeutic Outcomes) were the primary outcomes measures. Pain reduced to 0/10 and all patient exceeded their predicted outcome scores on FOTO. Additionally, all patients were categorized as low irritability at discharge.

DISCUSSION: The results of this case series describe the use of an irritability based classification system for treatment of adults with varying shoulder diagnoses. The positive results indicate that treatment guided by irritability may be beneficial for conservation treatment in a physical therapy setting. Further research, including randomized controlled trials, is needed in order to determine effectiveness in a larger population.


OP0257

PHYSICAL THERAPIST-LED CARE COORDINATION: A BIOPSYCHOSOCIAL APPROACH TO CHRONIC LOW BACK PAIN MANAGEMENT IN THE CLINICALLY COMPLEX PATIENT

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BACKGROUND AND PURPOSE: Low back pain (LBP) is one of the leading causes of disability worldwide. In the United States, LBP and diabetes mellitus (DM) are associated with over $483 billion in combined annual costs. Patients with clinically complex medical histories are described as having multiple comorbidities, including psychological, cardiovascular, and/or metabolic disease, frequently associated with polypharmacy. DPT training and time allotted with patients make physical therapists ideal care coordinators. PTs can assist in lowering cost of care in chronic LBP and DM in conjunction with the patient’s interdisciplinary team in an outpatient setting.

CASE DESCRIPTION: Patient is a 56-year-old man with high-irritability chronic LBP complicated by multiple DM type II, grand mal seizures, kidney stones, clinical depression, anxiety, hypertension, obstructive sleep apnea, hypercholesterolemia, migraines, gastroesophageal reflux disease, blood coagulation disorder, sigmoid diverticulitis, abdominal aortic aneurysm, and current use of vaporized tobacco with nicotine. PT-lead care coordination approach taken focusing on musculoskeletal, psychological, and metabolic impact of multiple morbidities on patient’s pain. Musculoskeletal care incorporated best practice principles per LBP clinical practice guidelines, in addition to referral coordination for appropriate footwear and orthotics. Psychological care emphasized patient education based on foundational principles of cognitive behavioral therapy and pain science. Metabolic care emphasized PT-MD team approach to management of DM in relation to nutrition, hydration, exercise, and medication management.

OUTCOMES: Outcome measures utilized included FOTO, NPRS, and the Berg Balance Scale. Patient demonstrated significant improvements in all outcome measures except for his low back FOTO measure. Pain decreased from high to low to moderate irritability. Muscle strength increased from 2+/5 to 4+/5 in bilateral lower extremities. Berg scores increased from 31/56 to 54/56 and patient remained free from falls at 4-month follow-up. Patient’s A1C reduced from 6.9% to 5.6%, average blood glucose level stabilized from 49 to 400 mg/dL to 114 mg/dL average. Emergency room utilization decreased. BMI reduced from 35.7 to 31.1. Patient was independent in blood glucose management via diet and aerobic program at conclusion of treatment.

DISCUSSION: With PT-led interdisciplinary care coordination chronic LBP, and metabolic dysfunction could be effectively managed. DPT training in differential diagnosis and nutrition make PTs valuable extensions to the primary care team. Through differential diagnosis, and increased time allowed with patients, physical therapists can effectively monitor and assist in implementation of lifestyle change to better treat LBP in medically complex patients.


OP0258

RELIABILITY AND FACE VALIDITY OF A NOVEL MOBILE DEVICE APPLICATION FOR 3-DIMENSIONAL SCAPULAR ANGLE MEASUREMENTS

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PURPOSE/HYPOTHESIS: Abnormal scapular motion is considered a potential contributing factor for individuals experiencing shoulder pain. However, scapular motion is difficult to measure objectively and accurately in clinic. Clinical tools designed to objectively measure scapular position must be easy-to-use, cost effective, and reliable. The purpose of this study was to determine the intrarater and interrater reliability, and face validity of a mobile device and application (The MnMotion System) in measuring 3-D scapular position during arm elevation in asymptomatic subjects.

NUMBER OF SUBJECTS: Twenty healthy subjects (16 female; average age, 23 years).

MATERIALS/METHODS: The MnMotion System application was custom designed for Apple iOS devices. The application derives 3-D position from an iPod’s 3 accelerometers, 3 axis gyroscopic sensors and Apple’s internal sensors. By aligning the iPod with the scapula, anatomic position of the iPod’s 3 accelerometers, 3 axis gyroscope sensors and Apple’s internal sensors fusion algorithm. By aligning the iPod with the scapula, anatomic position of scapular upward rotation (UR), scapular tilt, and internal rotation (IR) can be described. Measurement of scapular position was taken at rest, 90°, and 120° of humeral elevation in 3 planes: flexion, scapular abduction, and abduction. Measurements were taken under 2 conditions: (1) with the iPod directly contacting the scapula and (2) with the iPod secured to a custom designed handle. A board certified specialist in orthopaedic and sports PT with 14 years of clinical experience took 2 measurements with, and without the handle to measure intrarater reliability. To measure interrater reliability, 2 second-year physical therapy students took measurements with the handle, and 1 second-year student took measurements without the handle. A model 1,1 intraclass correlation coefficient (ICC) was performed for intrarater reliability, and a model 2,1 ICC for interrater reliability of the clinician and students. Descriptive data were also calculated.

RESULTS: Without the handle, 86% of intrarater reliability measurements
demonstrated ICC's greater than 0.75 (range, 0.58-0.98; SEM, 1.7°-5.5°). Without the handle, 76% of interrater reliability measurements demonstrated ICC's greater than 0.75 (range, 0.30-0.96; SEM, 3.1°-9.7°). With the handle, 85% of interrater reliability measurements demonstrated ICC's greater than 0.75 (range, 0.91-1.0; SEM, 1.7°-3.8°). Interrater reliability ICC's with student 1 ranged from 0.58-0.96 (SEM, 5.2°-13.8°). Interrater reliability ICC's with student 2 ranged from 0.30 to 0.64 (SEM, 6.6°-17.7°). The descriptive data during arm elevation demonstrated face validity with general patterns of increased UR and posterior tilt, as well as stable IR.

CONCLUSIONS: Use of the mobile device and app showed greater interrater reliability than interrater reliability. Measurements taken without the handle were more reliable between testers than those taken with the handle. Descriptive data demonstrated expected patterns of scapular motion.

CLINICAL RELEVANCE: The MnMotion System has potential as a reliable clinical tool to measure scapular position during arm elevation.

![Combined Sections Meeting](combined_sections_meeting)

**OPO259**

**RELIABILITY OF THE DYNA-RAIL: A NOVEL HANDHELD DYNAMOMETER STABILIZING DEVICE**

_Melissa Strzelinski_

**Physical Therapy, Howard Head Sports Medicine, Vail, Colorado**

**PURPOSE/HYPOTHESIS:** The available evidence examining dancer hip and lower extremity strength is sparse. Little to no information exists regarding the force production necessary to sustain positions of développé en avant, a la seconde, and arabesque (eg, high leg extensions). While handheld dynamometry is considered an efficient, effective, and portable means of objectively measuring lower extremity strength, it is often criticized for variability in results based on tester strength and gender. Furthermore, dynamometry has yet to be studied specific to dance relevant muscle strength. Use of an external stabilizing device has been suggested to minimize differences in outcomes between male and female testers, while providing more consistent results due to the reduction in variability associated with tester weakness. Therefore, the Dyna-Rail was designed as a portable stabilizing device to improve consistency of results among different testers for measuring hip and lower extremity strength. Use of the mobile device and app showed greater intrarater reliability than interrater reliability. Measurements taken without the handle were more reliable between testers than those taken with the handle. Descriptive data demonstrated expected patterns of scapular motion.

**CLINICAL RELEVANCE:** The MnMotion System has potential as a reliable clinical tool to measure scapular position during arm elevation.

**NUMBER OF SUBJECTS:** Eleven.

**MATERIALS/METHODS:** Professional and preprofessional ballet dancers were recruited to participate in a study evaluating the reliability of the Dyna-Rail. The primary investigator and a second tester assessed muscle force production of développé en avant, développé à la seconde, and arabesque on 2 separate occasions to establish intrarater and interrater reliability of the device. Results from 3 trials for each test position were recorded, with mean scores calculated and utilized for data analysis. Intraclass Correlation Coefficients (ICC) were determined for inter- and intrarater reliability, along with Standard Error of Measurement (SEM).

**RESULTS:** Interrater reliability was very high for développé en avant (ICC = 0.933; 95% CI: 0.822, 0.982) and développé à la seconde (ICC = 0.904; 95% CI: 0.737, 0.973), and high for arabesque (ICC = 0.763; 95% CI: 0.057, 0.937). Infrarater reliability was high for développé en avant (ICC = 0.899 and 0.758, tester 1 and 2, respectively) and développé à la seconde (ICC = 0.737 and 0.813, tester 1 and 2, respectively). SEM values were as follows: développé en avant, 0.415 to 0.589; développé à la seconde, 0.366 to 0.693; and arabesque, 0.634 to 1.12.

**CONCLUSIONS:** The dyna-rail is a reliable means of measuring force production in développé en avant and développé à la seconde in preprofessional and professional dancers. However, future study in the arabesque position is necessary to eliminate competitive bias of participants to attain more accurate reliability.

**CLINICAL RELEVANCE:** This presentation will provide insight into device development, utilization, and outcomes specific to the dancing population, and discuss potential application to handheld dynamometry for other test positions and the upper extremity. The results highlight the value of standardization and external stabilization of a handheld dynamometer for consistency in results.

**OPO260**

**IMPROVEMENTS WITH FUNCTIONAL MOBILITY IN A GERIATRIC PATIENT WHO HAS UNDERGONE KNEE ARTHROPLASTY AFTER INCLUDING HIGH-VELOCITY EXERCISE IN CONJUNCTION WITH PHYSICAL THERAPY: A CASE STUDY**

_Anthony Suarez, Zachary E. Walston, Dale M. Yake_

**PT Solutions Physical Therapy, Kennesaw, Georgia**

**BACKGROUND AND PURPOSE:** With a projected growth to 3.48 million by year 2030, knee arthroplasties is the gold standard for treatment for knee osteoarthritis. Although postop rehabilitation improves patients’ functional deficits, there is a lack of specific clinical practice guidelines for clinicians to utilize and to improve outcomes consistently and uniformly in all clinical practices. “Usual care” or standard physical therapy with this population has focused on recovery of full knee ROM, knee and hip strength, improvement of functional independence, and return to recreational activities with a focus on progressive exercise and early neuromuscular education stimulation to improve quad atrophy. High velocity, or power, exercise has been shown to improve functional mobility in healthy geriatric populations, however there is a gap in the literature in regards to the effect of performing power compound movement exercises with “usual care” with geriatric patients who have had a knee arthroplasty. The purpose of this case series is to highlight the functional benefits of including a multijoint exercise performed at high velocity in combination with “usual care” with a geriatric patient who has received a knee arthroplasty.

**CASE DESCRIPTION:** An 83-year-old woman with a recent partial knee arthroplasty was treated in an outpatient Physical Therapy clinic in Marietta, Georgia from February 2017 till April 2017. Patient had deficits with her knee active ROM, strength, balance, and functional mobility. Treatment consisted of “usual care” for postop total knee arthroplasty with the addition of the dead lift at loads of 40% to 70% 1 RM, which was dependent on patient’s irritability level, performed at high velocity for 3 to 4 sets of 5 to 6 reps with a 2-minute rest break between sets.

**OUTCOMES:** Pain, knee ROM, timed up-and-go (TUG) time, Berg balance, 5-times sit-stand, Focus On Therapeutic Outcomes Inc. (FOTO) were assessed prior to initiation of the dead lift exercise and then re-assessed 4 weeks later. The patient improved her knee active ROM, TUG time, 5x sit-stand time, and FOTO scores. Five-times sit-stand improved by 8.62 seconds (pretest, 20.1 seconds and posttest 11.48 seconds), TUG times improved by 1.02 seconds (pretest, 9.48 seconds; posttest, 8.46). FOTO scores improved by 8.9 (pretest, 58.4; posttest, 64.3). Knee ROM on the unaffected side had an improvement of 12° and the surgical side had an improvement of 10°.

**DISCUSSION:** Knee ROM, TUG times, 5-times sit-stand times, and FOTO scores improved with the patient. More subjects and a control group are required to determine the effect and significance of findings. The positive functional outcomes indicate that the inclusion of high velocity exercise with “usual care” may be a safe effective treatment progression. Further studies, including randomized controlled trials, are needed long-term functional benefits to establish a more effective clinical practice guideline with these patients.

Since there is no uniform adolescent dancer or health-related question. There remains a significant need for collaboration.

To create a uniform, evidence-based screening tool for adolescent dancers, there are significant opportunities for development.

The rubric includes an identification of the target dancer population (age, gender, level of training, etc.), orthopaedic conditions. In addition to the screening components, the rubric may assist in the creation of an injury prevention protocol and is suggested as part of a dancer's pre-season health check-up.

A dance-specific screen has been proposed as a critical component in the creation of an injury prevention protocol and is suggested as part of a dancer's pre-season health check-up. Dance USA has developed a Post-Hire Screening Assessment, designed for professional adult dancers.

Adolescent dancers may be particularly vulnerable to injury due to rapid physiological and biomechanical changes, requiring a different type of screen. Ideally, adolescent dancer screening instruments will be psychometrically tested for reliability, validity, and sensitivity.

The project purpose was to develop a rubric that can be used by clinicians to critically evaluate strengths and weaknesses of adolescent dancer screens.

Validating screening instruments for preprofessional dancers is a priority for the Performing Arts Special Interest Group (PASIG) of the Orthopaedic Section of the American Physical Therapy Association. A dance-specific screen has been proposed as a critical component in the creation of an injury prevention protocol and is suggested as part of a dancer's pre-season health check-up. Dance USA has developed a Post-Hire Screening Assessment, designed for professional adult dancers.

Adolescent, preprofessional dancers, who are particularly vulnerable to injury due to rapid physiological and biomechanical changes, may require a different type of screen. Ideally, adolescent dancer screening instruments will be psychometrically tested for reliability, validity, and sensitivity.

SUMMARY OF USE: To determine rubric categories, we searched Pulmed and Ingenta using the keywords, “dance screen,” “adolescent dance screen,” and “dancing injury,” yielding relevant papers, some over 10 years old. In addition, dance medicine specialists from the PASIG were contacted regarding their use and priorities for dancer screens. We used our rubric to evaluate 2 screens from published research and 6 from PASIG members who were contacted with follow-up questions regarding protocols. Each tool was evaluated for the inclusion of the following components:

1. muscular strength
2. balance
3. flexibility
4. joint structure/alignment
5. joint stability/laxity
6. personal demographics (age, menstruation, years of training)
7. height/weight, growth spurt
8. gait
9. eating habits/attitudes
10. dance technique
11. point shoe
12. general functional outcomes
13. general health survey
14. orthopaedic conditions. In addition to the screening components, the rubric includes an identification of the target dancer population (age, preprofessional, professional), availability of operational definitions and scales for each component, skill level required for test administrator, purpose of screen (to determine dancers’ risk for injury, identification of red flags, recommendations for health care intervention and/or exercise prescription), and psychometric testing. Each of the dancer screens evaluated included measures of structure, flexibility, balance, and muscle strength, however there was considerable variability in all other aspects evaluated using the rubric.

IMPORANCE TO MEMBERS: Since there is no uniform adolescent dancer screening tool or definition for a high-risk dancer, this rubric may assist clinicians in identifying tools that best meet the needs of the dancers they serve. Despite the lack of validation, dancer screens are a valuable tool for health care professionals to establish rapport with young dancers to increase the likelihood that they might seek care in the event of an injury or health-related question. There remains a significant need for collaborative efforts to create a uniform, evidence-based screening tool for adolescent dancers.

OPO261

A RUBRIC FOR EVALUATING ADOLESCENT DANCER SCREENS

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PURPOSE: The project purpose was to develop a rubric that can be used by clinicians to critically evaluate strengths and weaknesses of adolescent dancer screens.

DESCRIPTION: Validating screening instruments for preprofessional dancers is a priority for the Performing Arts Special Interest Group (PASIG) of the Orthopaedic Section of the American Physical Therapy Association. A dance-specific screen has been proposed as a critical component in the creation of an injury prevention protocol and is suggested as part of a dancer’s pre-season health check-up. Dance USA has developed a Post-Hire Screening Assessment, designed for professional adult dancers.

Adolescent, preprofessional dancers, who are particularly vulnerable to injury due to rapid physiological and biomechanical changes, may require a different type of screen. Ideally, adolescent dancer screening instruments will be psychometrically tested for reliability, validity, and sensitivity.

SUMMARY OF USE: To determine rubric categories, we searched Pulmed and Ingenta using the keywords, “dance screen,” “adolescent dance screen,” and “dancing injury,” yielding relevant papers, some over 10 years old. In addition, dance medicine specialists from the PASIG were contacted regarding their use and priorities for dancer screens. We used our rubric to evaluate 2 screens from published research and 6 from PASIG members who were contacted with follow-up questions regarding protocols. Each tool was evaluated for the inclusion of the following components:

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10. dance technique
11. point shoe
12. general functional outcomes
13. general health survey
14. orthopaedic conditions. In addition to the screening components, the rubric includes an identification of the target dancer population (age, preprofessional, professional), availability of operational definitions and scales for each component, skill level required for test administrator, purpose of screen (to determine dancers’ risk for injury, identification of red flags, recommendations for health care intervention and/or exercise prescription), and psychometric testing. Each of the dancer screens evaluated included measures of structure, flexibility, balance, and muscle strength, however there was considerable variability in all other aspects evaluated using the rubric.

IMPORANCE TO MEMBERS: Since there is no uniform adolescent dancer screening tool or definition for a high-risk dancer, this rubric may assist clinicians in identifying tools that best meet the needs of the dancers they serve. Despite the lack of validation, dancer screens are a valuable tool for health care professionals to establish rapport with young dancers to increase the likelihood that they might seek care in the event of an injury or health-related question. There remains a significant need for collaborative efforts to create a uniform, evidence-based screening tool for adolescent dancers.

OPO262

AN ONGOING PATIENT DIALOG OF BLOOD PRESSURE EDUCATION

IN ORTHOPAEDIC PHYSICAL THERAPY: A CASE REPORT

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BACKGROUND AND PURPOSE: Blood pressure (BP) education as it relates to hypertension (HTN) is a vital component in outpatient physical therapy (PT). HTN is described as a silent killer and often asymptomatic. It’s the leading risk factor for cardiovascular disease (CVD) mortality accounting for 13% of global deaths and is the leading cause of CVD globally. In the United States, 32.7% of females and 36.8% of males that are older than 45 years old have high BP. With a majority of patients in outpatient PT older than 45 years, BP examination and education needs to be considered. This case report describes the successful management of a patient with HTN with emphasis on BP education and self-efficacy throughout the plan of care.

CASE DESCRIPTION: A 61-year-old man presented with a 3-year history of right (R) sided hamstring and calf pain. His pain began after slipping on ice and falling on his back. Pain intensity on the numeric pain-rating scale (NPRS) was 10/10 upon aggravation and no relief with self-treatments. He could only sleep for 3 hours at a time and walk just half mile distances. Past medical history included uncontrolled HTN, hyperlipidemia, and asthma. At evaluation, the patient’s resting BP presented as 158/104 mmHg. Lumbar movements with overpressure were normal, positive slump test on (R), and an inability to lie supine. Unilateral posterior-to-anterior accessory motion at S1 reproduced his symptoms. He was not taking prescribed HTN medications due to past side effects he experienced. Referred to his primary care physician (PCP) for new medications and encouragement of self-efficacy was recommended. Subsequent visits were used for improvement of sleeping and walking along with BP monitoring and education of his HTN.

OUTCOMES: The patient was seen for 12 visits over 3 months and improved with treatment directed at his lumbar and sacral spine. His hamstring and calf pain on the NPRS improved to 0/10 with activity. Slump test improved to lacking 19° of knee flexion. He scored 7 on the global rating of change at discharge and was able to return to normalized walking and sleeping patterns. He was reluctant of HTN recommendations and tried multiple alternatives to control his HTN with no success. At visit 7, he recognized the need to see his PCP for his dangerously high levels of BP. The patient received new medications with improved BP ranges within 130 to 140 systolic and 90 to 66 diastolic mmHg and 135/100 mmHg at discharge. He scheduled a follow-up visit with his PCP for adjustments of medication for continued treatment of his HTN.

DISCUSSION: Consistent BP education and promotion of self-efficacy directed toward a patient with uncontrolled HTN with an orthopaedic pathology resulted in significant changes in the patient's understanding and control of his HTN. He recognized the danger of his high BP levels and took action to prevent possible secondary consequences. This case report demonstrates the grave importance of successful examination and management of patients with uncontrolled HTN in the outpatient PT setting that have orthopaedic needs.


OP0263
THE EFFECT OF A STRUCTURED TREATMENT PROGRAM CONSISTING OF MANUAL THERAPY, DRY NEEDLING, AND ECCENTRIC EXERCISE TO IMPROVE FUNCTION AND REDUCE PAIN IN PATIENTS WITH ACHILLES TENDINOPATHY: A CASE SERIES
Kevin Sweiboda, Dale M. Yake, Zachary E. Walston
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BACKGROUND AND PURPOSE: Achilles tendinopathy is defined as the disease process of the Achilles tendon that includes tenderness to palpation as well as increased symptoms with activity. Often referred as a tendinitis, Achilles tendinopathy typically presents with a lack of palpable inflammation and is usually more chronic in nature. Increased tendon thickness is often seen as well as increased or decreased talocrural dorsiflexion range of motion. Progressive eccentric loading has been shown to improve function and reduce pain in this population. Currently there is a paucity of literature to support other interventions in the treatment of Achilles tendinopathy. The purpose of this case series was to describe the outcomes of manual therapy, lumbar thrust manipulation and dry needling as adjuncts to an eccentric loading program to manage patients with Achilles tendinopathy.

CASE DESCRIPTION: Three patients between the ages of 25 and 56 years were treated in an outpatient physical therapy setting in Candler, North Carolina. All 3 patients reported pain at the Achilles tendon. Interventions utilized in this case series included lumbar thrust manipulation, dry needling to myofascial trigger points and the Achilles tendon, and eccentric loading. Pain and function were assessed at initial evaluation and at discharge.

OUTCOMES: A total of 3 patients participated in this case series with ages ranging from 25 to 56 years. At the conclusion of treatment, each patient demonstrated improvement in open and closed chain dorsiflexion, and reduced pain score. The mean improvement in function as measured by the Foot and Ankle Ability Measure (FAAM) was 48.8%. Two of the 3 patients improved repetitions on the planter flexion endurance test from 0 to at least 20 repetitions. Only 1 patient did not reach a pain score of 0 at discharge.

DISCUSSION: This study demonstrated significant improvement in FAAM, FOTO, and function in 3 patients with age ranging from 25 to 56 years with Achilles tendinopathy. The outcomes of this case series suggest that the use of a structured treatment program using manual therapy to the ankle, lumbar manipulation, progressive eccentric exercise and dry needling may be effective interventions to improve pain and function in patients with Achilles tendinopathy. However, further randomized controlled studies are needed to better validate this treatment approach.


OPO264

ASSESSING MEANINGFUL CHANGE IN THE PROMIS PHYSICAL FUNCTION WITHIN AN OUTPATIENT ORTHOPAEDIC PHYSICAL THERAPY SETTING

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University of Utah, Salt Lake City, Utah; Orthopaedics, University of Utah, Salt Lake City, Utah; Physical Therapy, University of Utah, Salt Lake City, Utah; Physical Therapy and Athletic Training, University of Utah, Salt Lake City, Utah; Population Health Sciences, University of Utah, Salt Lake City, Utah

PURPOSE/HYPOTHESIS: The National Institutes of Health Patient Reported Outcomes Measurement System (PROMIS) Physical Function Computer Adaptive Test (PFCAT) was developed to advance the methodology of patient reported outcomes across health services. The APTA outcomes registry supports the use of the PFCAT as a valid and reliable tool for measuring general function. Quantifying a meaningful change on the PFCAT is critical to clinical decision and measuring quality of care. This study examined the responsiveness of the PROMIS PFCAT in a general outpatient physical therapy clinic.

NUMBER OF SUBJECTS: Analysis included 3991 individuals (57% female; mean age, 47.6 years) receiving care in an outpatient orthopaedic clinic and who had at least 2 visits and completed a global rating of improvement. Patients were seen between September, 2015 and March, 2017.

MATERIALS/METHODS: Patient demographic and clinical data were retrieved from the electronic medical record. Patient reported outcomes were collected at each visit as part of routine clinical processes. On follow-up visits, patients were asked to complete a 5-level global rating of improvement scale. A minimal important change was considered a response of “some relief of symptoms” (versus little, no, or worsening of symptoms) on the global rating scale. Responsiveness was examined using both distribution-based methods (standardized response means [SRM]) and anchor-based methods (receiver operating characteristic curves).

RESULTS: At baseline, the mean PFCAT score was 42.78 ± 8.21 and the mean pain score was 3.91 ± 2.34. Patients received an average of 5.32 ± 3.34 visits over a median 38 days. At the end of the PT episode of care, 31% of the sample reported great relief of symptoms, 47% reported some relief of symptoms, 21% reported no change and 1% reported worsening of symptoms. Mean PFCAT change was 7.86 (95% CI: 7.41; 8.31) for patients reporting great relief of symptoms, 2.73 (95% CI: 2.45; 3.01) for patients reporting some relief of symptoms, and 0.54 (95% CI: 0.14; 0.05) for patients reporting no change. SRMs across these groups were 0.98, 0.44, and 0.09 respectively.

CONCLUSIONS: In a general population presenting to outpatient physical therapy, a change between 2 and 3 points on the PROMIS PFCAT can be considered a meaningful change.

CLINICAL RELEVANCE: The PROMIS PFCAT is an efficient general measure of function that can be used to measure across patients with different health conditions. Patients reporting 2 to 3 points of change in their PFCAT score can be considered to have benefited from outpatient physical therapy treatment.

OPO265

CAN VERSUS DO: USING WALKING SPEED AND MODERATE-TO-VIGOROUS PHYSICAL ACTIVITY TO PREDICT INCIDENT LOW HEALTH-RELATED QUALITY OF LIFE AND DISABILITY

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PURPOSE/HYPOTHESIS: Walking speed is a measure of performance, ie. what people “can” do, and is a predictor of future health, disability, and mortality in older adults. Time in moderate-to-vigorous physical activity (MVPA), is a complementary measure of the frequency of behavior at an intensity, ie. what people “do,” and is also associated with future health. It is unclear how walking speed and MVPA are jointly associated with future health. The purpose of this study was to examine the associations of combined walking speed (what people “can” do) and MVPA (what people “do” categories with health-related quality of life (HR-QoL) and disability in adults with/at risk of knee osteoarthritis (OA).

NUMBER OF SUBJECTS: One thousand eight hundred seventy-six from the Osteoarthritis Initiative (OAI).

MATERIALS/METHODS: We used data from the OAI, a large cohort of people with/at risk for knee OA. Walking speed and MVPA were collected at the 48-month visit. Walking speed was calculated from a 20-m walk test. MVPA was measured with an accelerometer (Actigraph GT1M) worn at the hip for greater than 10 h/d for greater than 4 days, and defined as greater than 2020 counts/min. We classified people as Fast-Active (greater than 1.2 m/s and MVPA greater than 11 min/day, median value of the sample), Fast-Inactive (greater than 1.2 m/s and MVPA less than 11 min/d), Slow-Active (less than 1.2 m/s and MVPA greater than 11 min/d), and Slow-Inactive (greater than 1.2 m/s and MVPA less than 11 min/d). Study outcomes were incident low HR-QoL measured with the Short-Form 12 Physical Component Score (SF-12 PCS) less than 40 indicating low HR-QoL and incident disability measured with the Late Life Disability Instrument (Limitation Score [LLDI-L] less than 50 and Frequency Score [LLDI-F] less than 70 indicating disability) measured 4 years later. We calculated risk ratios and 95% confidence intervals (RR [95% CI]) adjusting for potential baseline confounders.

RESULTS: Of 1876 people with baseline walking speed and MVPA data (55% women; mean ± SD age, 65.1 ± 9.1 years; BMI, 28.4 ± 4.8 kg/m²), 1419, 1250, and 1413 people were free of the outcome at baseline and had 4-year follow-up data for the PCS, LLDI-L, and LLDI-F, respectively. At the 4-year follow-up, 15%, 15%, and 11% of the analytic sample developed low HR-QoL and disability (LLDI-L, LLDI-F, respectively). The Fast-Inactive and Slow-Inactive groups had similar risk. The Slow-Inactive group had 1.8 (1.2, 2.7) times the risk for incident low HR-QoL compared to the Fast-Active group; the Slow-Active group had similar risk. The Slow-Inactive group had 1.6 (1.1, 2.2) and 1.7 (1.1, 2.5) times the risk of incident low HR-QoL compared to the Fast-Inactive and Slow-Inactive groups, respectively. The groups had similar risk for incident disability.

CONCLUSIONS: Compared to people who were fast and active, those who were slow and active were at similar risk, those who were fast and inactive had greater risk of low HR-QoL, and those who were slow and inactive had greater risk of developing low HR-QoL and disability.

CLINICAL RELEVANCE: Advising patients to “do,” ie. spend more time in MVPA (eg. a brisk walk), may be as or more important than ensuring that
they “can” do, i.e. walk fast enough for community ambulation, to prevent the development of future low HR-QoL.

**OP0266**

**PREDICTORS OF INJURY FOR BASEBALL PITCHERS HIGH SCHOOL LEVEL AND ABOVE**

**Jeffrey A. Thompson, David Atwood, Matthew Creel, Steven Poche**

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**PURPOSE/HYPOTHESIS:** In the United States over 500,000 athletes, high school level and above, participate in competitive baseball each year. Each position played in baseball provides a unique set of risks to the musculoskeletal system. For baseball pitchers, high levels of repetitive torques and forces are placed upon the muscles, tendons, and ligaments of the shoulder, elbow, and wrist. With pitcher having been identified at increased rate of injury to the throwing arm, researchers have attempted to predict those at the highest risk. Despite studies on biomechanical variables, there is a lack of critical appraisal evaluating the current level of evidence for identifying risk in this specific population. This study systematically reviewed evidence to detail the level of evidence for predictor variable of injury in pitcher high school age and above.

**NUMBER OF SUBJECTS:** Eight studies were reviewed totaling 777 subjects.

**MATERIALS/METHODS:** A literature search including PubMed, CINAHL, Ebscohost, Science Direct, and SportDiscus was performed. A filter was added to all searches for the earliest publication date to be January 1, 2000. “Baseball/injuries” and “upper extremities” were used as MeSH terms for Pubmed and subject terms for CINAHL. Key word searches were performed in Ebscohost, Science Direct, and SportDiscus using “upper extremity,” “baseball,” “pitch,” “injury,” and “prospective.” Studies were graded for quality and potential bias by 3 reviewers using the Quality in Prognosis Studies (QUIPS) tool.

**RESULTS:** A total of 362 titles and abstracts were identified from the 5 database searches. Duplicates were removed, which left 289 articles. After screening the titles, abstracts and hand search, a total of 8 articles met all inclusion and exclusion criteria for this systematic review. These 8 articles were given a quality score using the Oxford Levels of Evidence 2 for prognostic studies. Half of the included studies were cohort studies, receiving a quality score of level 3. The other half of the included studies were case-control studies and received a quality score of level 4. The QUIPS tool overall score was “high” for 6 studies and “low” for 2 studies.

**CONCLUSIONS:** Based on the results, preseason screening for supine and seated shoulder internal (IR) and external rotation (ER) strength, supraspinatus strength, shoulder (IR) and (ER) ranges of motion, total shoulder rotational motion, and pitch velocity were predictors of injury. Future studies should evaluate other biomechanical variables (ie, hip strength and ROM) as predictors of injury, as well as prevention success rates based off of high-risk designation.

**CLINICAL RELEVANCE:** Current evidence supports preseason screening for baseball athletes to identify those at risk for injury based on specific predictor variables mentioned in this review. However, specialized training and equipment may be required to perform some tests and measures. By identifying those at risk throwing athletes, injuries rates may be decreased.

**OP0267**

**EFFICACY OF INSTRUMENT-ASSISTED SOFT TISSUE MOBILIZATION FOR THE TREATMENT OF MUSCULOTENDINOUS INJURIES: A SYSTEMATIC REVIEW**

**Jeffrey A. Thompson, Landon Crowder, Daniel Le, Adam J. Roethele**

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**PURPOSE/HYPOTHESIS:** Instrument assisted soft tissue mobilization (IASTM) is a noninvasive method to mobilize soft tissue structures such as muscles, tendons, or ligaments. IASTM has been purported to positively impact speed of recovery, tissue regeneration, and range of motion. Previously published article included pathologies that were not musculotendinous and excluded a form of IASTM. The purpose of this study was to evaluate the clinical efficacy of using instrument assisted soft tissue mobilization for the treatment of musculotendinous injuries and the clinical outcomes that result from use.

**NUMBER OF SUBJECTS:** Twelve studies were reviewed totaling 452 subjects.

**MATERIALS/METHODS:** A literature search including PubMed, Cochrane, Ebsco, Index of Chiropractic Literature, ProQuest, PEDro, and Clinicaltrials.gov was completed in March 2016. Search terms included: “instrument assisted soft tissue mobilization,” “IASTM,” “augmented soft tissue mobilization,” “ASTYM,” “Gastrow,” and “GISTM.” Titles and abstracts were screened for relevance, inclusion, and exclusion criteria. Each article was critically appraised by the 3 independent reviewers using the PEDro scale and Levels of Evidence obtaining 100% agreement. Articles which graded 6/10 or greater on the Pedro scale were considered to be high quality and have a low risk of bias. The level of evidence present in each study was assessed using the Oxford Centre for Evidence-based Medicine Levels of Evidence. Only randomized control trials, clinical control trials, or pilot studies were included.

**RESULTS:** The average PEDro score of the 12 studies was found to be 5.4/10. Points were only awarded toward the PEDro score when the article being appraised explicitly stated each criteria being assessed. Six subgroups of interventions were found and analyzed: IASTM versus no treatment, IASTM versus self-stretch, IASTM versus a sham IASTM intervention, IASTM versus foam rolling, IASTM versus cross friction soft tissue mobilization, and IASTM versus a stretching and/or strengthening program. Moderate evidence supports the use of IASTM combined with stretching and strengthening protocols when treating tendinopathies such as lateral epicondylitis and insertion achilles tendinopathy but this evidence arises from only 1 high-quality study supporting each pathology. There is weak evidence supporting the use of IASTM for increasing ROM, and only for an acute time period.

**CONCLUSIONS:** There is insufficient evidence supporting the use of IASTM as a stand alone treatment for all musculotendinous pathologies. Moderate evidence does exist to support the use of IASTM in combination with stretching and strengthening programs.

**CLINICAL RELEVANCE:** The quality and quantity of current evidence is not sufficient to support the efficacy of IASTM as the sole treatment. Limited quantities of moderate evidence exists for improved outcomes using IASTM as a potential supplement to a stretching and strengthening protocol for musculotendinous injuries.

**OP0268**

**EFFECT OF PROGRESSIVE RESISTANCE EXERCISE ON ACTIVITY AND PARTICIPATION IN INDIVIDUALS WITH CHRONIC LOW BACK PAIN: A SYSTEMATIC REVIEW**

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**PURPOSE/HYPOTHESIS:** Current literature and clinical practice guidelines strongly supports exercise, including resistance exercise, as an important intervention for individuals with chronic low back pain (CLBP). Although resistance exercise is recommended specific parameters are generally not provided. The purpose of this systematic review was to determine if clearly identified progressive resistance exercise (PRE) parameters have a positive effect on function in individuals with CLBP.

**NUMBER OF SUBJECTS:** Nine total participants 616 (intervention, 458; control, 158).

**MATERIALS/METHODS:** A computer-aided literature search (Medline,
Combined Sections Meeting

CINHAL, Rehabilitation and Sports Medicine Source January 1996 to April 2017) was performed to identify relevant randomized control trials. Of the 1474 articles screened 9 met the inclusion criteria of having clearly defined parameters for exercise dosage and progression. Activity and participation outcome measures such as the Oswestry Disability Index (ODI) and Roland-Morris Disability Questionnaire (RMDQ) were required for each article. Two reviewers independently verified that the articles met the inclusion and exclusion criteria. A third reviewer resolved any disagreements. The PEDro scale was used to assess quality of the articles.

RESULTS: Two broad types of interventions were used for the experimental groups. Four studies used isolated lumbar extension resistance (ILE), 3 used total body resistance, and 2 studies included both. Initial intensities were set at 50% tp 80% of 1 repetition maximum for all studies. The methods for progression varied greatly. The duration varied between 8 to 16 weeks with a frequency of 1 to 4 days per week. Activity and participation was assessed using the ODI in 7 studies, the RMDQ in 3 studies, and gait speed and walking endurance in 1 study. A minimally important clinical difference of 10.0 for the ODI, 5 for the RMDQ, or 0.05 m/s for gait speed was achieved in 7 of the 9 studies. When compared to a control group significant improvement was noted in 2 of 6 studies for isolated lumbar extension and 5 of 5 studies for total body resistance. Two of 2 studies reported significant improvement for total body resistance versus ILE exercise. The quality of the articles ranged from 4 to 8 with a mean of 6.7.

CONCLUSIONS: There is moderate level evidence that PRE is beneficial in improving activity and participation for individuals with CLBP. Although the number of studies is limited there appears to be an advantage of total body resistance exercise over ILE exercise.

CLINICAL RELEVANCE: CLBP is a common condition and practical treatment options are necessary for long-term management. Although optimal dosage and progression parameters have not been established the results of this review provide confidence that varied PRE programs can be utilized successfully in clinical practice.

OPO269

CO-OCCURRENCE OF THE MCKENZIE MECHANICAL SYNDROMES AND CENTRAL SENSITIZATION: A DESCRIPTIVE STUDY OF CHRONIC NECK PAIN

Patients

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PURPOSE/HYPOTHESIS: Chronic neck pain is a highly prevalent and disabling condition in which treatment outcomes can be enhanced through classification models, and ultimately, stratification of care. A commonly utilized classification model for musculoskeletal conditions, such as neck pain, is the McKenzie Method of Mechanical Diagnosis and Therapy (MDT). However, MDT is not as extensively researched for neck pain as it is for other conditions and has not been assessed in conjunction with latest evidence for biopsychosocial influences: mainly, central sensitization (CS) and psychological distress. Therefore, the purpose of this study is to: (1) determine the percentage of patients categorized into the mechanical MDT subgroups (derangement, dysfunction, postural); (2) characterize the biopsychosocial clinical profile (test for the presence of CS and psychological distress); and (3) identify associations between pain, disability and biopsychosocial influences among this cohort.

NUMBER OF SUBJECTS: Eighty-four consecutive patients with chronic (great-er than 6 months) neck pain.

MATERIALS/METHODS: Patients were recruited via their treating therapists, who were trained in the MDT approach. Therapists classified patients into 1 of the 3 MDT subgroups (derangement, dysfunction, postural) or “other.” In addition, patients completed an online questionnaire providing data on CS (central sensitization inventory [CSI]), psychological distress (Tampa Scale Kinesiophobia [TSK] and Pain Catastrophizing Scale [PCS]), and perceived disability (Neck Disability Index). Descriptive statistics provided percentages for the 4 MDT subgroups, as well as the presence of CS, psychological distress, and disability. Odds ratios were generated to assess associations with MDT and biopsychosocial influences.

RESULTS: Ten therapists recruited 84 patients (mean pain intensity, 5.42 ± 2.05/10). The percentages of patients classified into each mechanical subgroup (derangement, dysfunction, postural) and the “other” subgroup were 75.6%, 2.5%, 1.2%, and 20.7%, respectively. Nearly 65% of patients presenting with a derangement also demonstrated signs of central sensitization. Moreover, CS was positively associated with pain intensity in this cohort (P<0.05), almost 40% of the patient presented with (1) a mechanical component (derangement), (2) signs of nervous system hypersensitiv-ity (CSI score greater than 40) and (3) a significantly high level of kinesiophobia (TSK greater than 37).

CONCLUSIONS: To our knowledge, this is the first study to characterize MDT classification in conjunction with biopsychosocial influences for a cohort of individuals with chronic neck pain.

CLINICAL RELEVANCE: Considering that the majority of our patients were classified as “derangement,” and those presenting with derangement also present with either CS and/or psychological distress, our results suggest that MDT classification and biopsychosocial influences are not mutually exclusive. Without assessing CS and psychological distress in addition to MDT classification, physical therapists may miss crucial prognostic/diagnostic information.

OPO270

THE RELATIONSHIP BETWEEN FUNCTION, ACTIVITY, AND WEIGHT CHANGE: AN EXPLORATION OF THE COMPLEXITY OF WEIGHT LOSS AND GAIN FOLLOWING KNEE REPLACEMENT SURGERY IN MEN

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PURPOSE/HYPOTHESIS: Small reductions in weight can decrease osteoarthritic knee pain. Intuitively this should provide a strong incentive for weight-loss. However many people undergoing knee joint replacement are categorised as obese. Counterintuitive studies also show that patients are more likely to gain weight after KJR. We aimed to understand the reasons why people with painful knees do not lose weight, either before or after KJR, contrary to the expectations of patients’ and their health care professionals that they will (or should). Gender theories can help us to understand differential responses to illness and therefore make an important contribution to rehabilitation. We aimed to explore barriers to weight loss in a group of older men with osteoarthritis.

NUMBER OF SUBJECTS: Six.

MATERIALS/METHODS: We conducted 12 in-depth interviews, before and 1 year after surgery, with 6 “obese” men listed for knee joint replacement BMI greater than 30 kg/m2. Interviews were digitally recorded and transcribed verbatim. Analysis was influenced by constructivist grounded theory. We abstracted conceptual themes from the data through constant comparison.

RESULTS: Our findings demonstrate a tension in men’s body talk that might influence their health care decisions. We identified the following themes: (1) I am big and healthy and don’t need to lose weight; yet (2) being this size isn’t good for me. Men discussed reasons that they might put on weight which might be potential barriers to weight loss: (3) I have worked hard all my life; (4) I am not as active as I don’t have to worry about that sort of thing; (5) I have worked hard all my life; (6) what is the point in trying anyway?

CONCLUSIONS: Gendered narratives can make it challenging for men to lose weight. Health care professionals cannot ignore the influence of gender on rehabilitation and should consider gender specific strategies.

CLINICAL RELEVANCE: An understanding of the complex factors around weight gain, weight loss and surgical interventions can inform the arthro-
plasty practitioner when having conversations with patients about the decision to be referred for arthroplasty surgery.

**OP0271**

**EFFECTS OF AGING AND POSITION ON LOAD-DISPLACEMENT RELATION OF THE GLENOHUMERAL JOINT IN ASSOCIATION WITH ANTEROPOSTERIOR GLIDE MOVEMENT**

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**PURPOSE/HYPOTHESIS:** This study aimed to investigate age and gender related changes in mechanical properties of the glenohumeral joint (GHJ) en masse during A-P glide movement (AGP). We hypothesized that younger subjects (YG) would have greater displacement but smaller stiffness than those of older subjects (EG) in neutral and rotated positions.

**NUMBER OF SUBJECTS:** Twenty-two participants (mean ± SD age, 23.95 ± 2.01 years) in YG and 16 middle-aged participants (age, 55.38 ± 7.11 years) in EG.

**MATERIALS/METHODS:** The participant lay supine with humerus positioned in the plane of scapula. AGP was performed by a 6-DOF robotic arm with a ramped load up to 7 kg on humeral head in a direction perpendicular to the plane of scapula. Participants were tested randomly in 60° external rotation (ER), neutral rotation (NP), and 60° internal rotation (IR). Magnitudes of displacement of the robotic end effector and forces registered by the load cell were extracted to construct the load-displacement curves (LDCs). The displacement, force, and stiffness at the following points on the LDCs were computed: (1) beginning of toe-region (T1), (2) end of toe-region (T2), (3) intersection point of lines representing neutral-zone and linear-elastic region (Pint). A 3-way mixed-model ANOVA with repeated measures was employed to assess main effects of age, sex, and position on displacement, force, and stiffness parameters.

**RESULTS:** Age effects were observed in all parameters (P values ranged from .000-.018) except the force at Pint and the stiffness at T2. The interaction between position and age of displacement parameters were found (P = .008-.038). In YG, the magnitudes of displacement observed in ER were greater than those of IR at Pint (t = –2.498, P = .021), yet reversed at T2 (IR greater than ER: t = 2.249, P = .035). However, in EG, magnitudes of displacement in IR were consistently greater than those of ER at the toe region (t = 3.566, P = .003) and T2 (t = 2.876, P = .012).

**CONCLUSIONS:** At the early toe region in YG, the primary restraint during AGP movement is more relaxed in ER position, and thus, allows a greater magnitude of displacement than that of the IR position (ER greater than IR). However, at the late toe region in YG and the toe region in EG, the relative magnitude becomes reverse (IR greater than ER). It may indicate aging leads to differential changes in the mechanical properties of GHJ structures responsible for restraining AGP movement and, therefore, the order or degree of recruitment of individual GHJ capsuloligamentous structures during AGP loading.

**CLINICAL RELEVANCE:** The conclusions of the present study suggest that aging leads to differential changes in the mechanical properties of GHJ structures responsible for restraining AGP movement and may have resulted in changes in the order or degree of recruitment of individual GHJ capsuloligamentous structures during AGP loading. It is necessary to take into consideration of such changes during the assessment and treatment of the GHJ in the elderly population.

**OP0272**

**CASE STUDY REPORT: PHYSICAL THERAPY TREATMENT OF A CHRONIC DEEP DIGITAL FLEXOR TENDON INJURY IN AN 8-YEAR-OLD THOROUGHBRED MARE**

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**BACKGROUND AND PURPOSE:** With an APTA special interest group focusing on animal rehabilitation, more scholarly work describing effective rehabilitation practices for animals is needed. The purpose of this case study is to describe the successful physical therapy treatment of a chronic deep digital flexor tendon tear in an 8-year-old thoroughbred mare.

**CASE DESCRIPTION:** This 8-year-old retired racehorse was diagnosed via ultrasound with a longitudinal tear of the deep digital flexor tendon in the left front limb. The injury took place when the mare experienced some minor trauma to the tendon at the base of the leg on the posterior aspect of the middle pastern just proximal to the hoof. There was no open laceration at the time of injury, but some of the hair was worn off and the mare began limping 2 to 3 days after the initial incident. After 31 weeks of unsuccessful treatment by the owners and a local veterinarian, the mare had declined to such an extent that the owners were considering euthanasia.

At this time, a physical therapy treatment plan was developed. At the initial physical therapy evaluation, the horse had been on stall rest for 31 weeks and was mobilizing within the stall by hopping on the 3 unaffected limbs with only occasional weight bearing through the affected limb.

Based on the history, and through physical assessment, the movement diagnosis was deep digital flexor tendon contracture with scar tissue limiting range of motion and function.

**OUTCOMES:** After approval was received from the vet, weekly physical therapy treatments began. Physical therapy took place 1 time per week for the next 6 months. Physical therapy treatment methods included activities to encourage weight bearing in the affected limb, scar massage, PROM, stretching, cryotherapy and a progressive exercise program. After 12 weeks of physical therapy treatment (43 weeks after the initial injury), the mare improved to perform weight bearing on the affected limb 100% of the time during walking gait with no hopping. After 13 weeks of treatment, the mare was consistently sound (without a limp) at the walk. After 24 weeks of treatment (55 weeks after initial injury), the mare progressed to trotting a few minutes at a time in each direction. At the time of this abstract, the mare was intermittently sound at the trot. Progression to canter will not take place until the mare is consistently sound at the trot for 2 to 3 weeks.

**DISCUSSION:** This case study demonstrates the effectiveness of standard physical therapy practices in treating a orthopedic injury which commonly occurs in equine athletes. Although the animal had not achieved a full recovery at the time of this submission, her condition had improved considerably and her prognosis for full recovery is excellent. The outcomes of this case demonstrate the important role of physical therapy in animal rehabilitation.

**REFERENCES:**


**OP0273**

**RELIABILITY OF A NEW FRONTAL PLANE TRAPEZIUS MANUAL MUSCLE TEST**

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PURPOSE/HYPOTHESIS: Research has shown Kendall’s manual muscle testing (MMT) positions to be the gold standard. The MMT positions for the upper, middle, and lower trapezius test the elevation, adduction, and depression of the scapula; however, the upward rotation component of the muscle is not tested. Cibulka et al. introduced a new MMT position that tests the trapezius as a whole in the frontal plane and includes the upward rotation component. The new test was created to be a more effective and functional test of the trapezius. The purposes of this study were to provide further information on the reliability and validity of the new test position and to streamline the testing process to increase participant recruitment and clinical application.

NUMBER OF SUBJECTS: The study included a convenience sample of 33 healthy participants ranging from 18 to 55 years of age.

MATERIALS/METHODS: Test order and upper extremity to be tested were randomized. Three electrodes were used as ground leads and 3 were placed over the muscle bellies of the upper, middle, and lower trapezius. All subjects were tested using Kendall’s positions for the trapezius and the new test position. One researcher positioned and tested all participants. A make test followed by a break test was performed twice in each test position. Data were collected using electromyography (EMG) and hand held dynamometry (HHD). The tester and participant were blinded to the EMG and HHD results. EMG data of maximal voluntary isometric contraction (MVIC) in the upper, middle, and lower trapezius were analyzed for comparison of standardized positions and the new position. EMG data were normalized to allow comparison of muscle activity during the Kendall MMT and the new test. The normalized EMG activity and the HHD data were analyzed using descriptive statistics and intraclass correlation coefficients.

RESULTS: When preforming an intraclass correlation coefficient (ICC) for test-retest reliability for the EMG data a value of 0.869 (95% CI: 0.733, 0.936) for the upper trapezius; 0.557 (95% CI: 0.135, 0.777) for middle trapezius; and 0.902 (95% CI: 0.799, 0.952) for the lower trapezius. The upper trapezius demonstrated an extremely high MVIC for the new test position (mean ± SD, 143.552% ± 77.647%). The middle trapezius demonstrated high MVIC for the new position (mean ± SD, 65.485% ± 27.539%). The lower trapezius also demonstrated a high MVIC (mean ± SD, 51.485% ± 31.196%).

CONCLUSIONS: The new frontal plane trapezius test provides a functional MMT that has been absent in physical therapy. The upper and lower trapezius demonstrated good test-retest reliability while the middle trapezius showed low reliability.

CLINICAL RELEVANCE: The new test position is a reliable test of the whole trapezius muscle, but should not replace Kendall’s standard MMT positions. More research is encouraged to determine the effect of the new test on individuals with shoulder pathology.

USE OF Y BALANCE TEST FOR PERSONS WITH CHRONIC ANKLE INSTABILITY

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PURPOSE/HYPOTHESIS: Persons with lateral ankle sprains either develop chronic ankle instability (CAI) with residual postural control deficits or are able to return to their preinjury levels as Copers. The Y Balance Test (YBT) has recently been developed from the Star Excursion Balance Test (SEBT) as an assessment of dynamic postural control. While YBT has been used with athletes, service members, and healthy adults, its usage for persons with CAI and Copers has been limited. The purpose of the current study was to (1) examine the interrater reliability of YBT and (2) compare YBT performance among individuals with unilateral CAI, Copers and healthy adults.

NUMBER OF SUBJECTS: CAI (n = 18; mean ± SD age, 22.4 ± 2.8 years; Identification of Functional Ankle Instability [IdFAI], 21.3 ± 8.3 and copers [COP]; n = 15; age, 22.4 ± 3.2 years; IdFAI, 7.3 ± 2.5) and healthy controls (CON; n = 18; age, 22.2 ± 3 years; IdFAI, 2.9 ± 3.1).

MATERIALS/METHODS: For the YBT, subjects performed 3 practice trials for each leg in each of the 3 directions: Anterior (ANT), posterior medial (PM), and posterior lateral (PL). Maximum reach values of 3 trials for each direction were recorded by the same examiner for all subjects, normalized with leg length and used to calculate a composite score. Additionally, for 8 participants scores were recorded independently and concurrently by another examiner. Intraclass correlation coefficients (ICC) were used to determine the interrater reliability of the maximum reach and composite scores bilaterally. A t-way ANOVA was used to determine the differences among the injured side of CAI and COP and dominant side of healthy controls for all the dependent variables.

RESULTS: The interrater reliability was excellent (greater than 0.841) for all measures. Composite score was significantly lesser for persons with CAI (93.2 ± 6.5 cm) compared to CON (100.1 ± 6.8 cm, P = .015). Composite score for COP (95.2 ± 8.0 cm) was not different than others. ANT maximum reach was lesser for persons with CAI (66.8 ± 7 cm) compared to CON (72.5 ± 6.5 cm) showing a trend towards significance (P = .052). Maximum reach in ANT for COP (68 ± 7.2 cm) was not different than others. Groups were similar in maximum reach scores for PM (CAI, 108.3 ± 8.8 cm; COP, 109.3 ± 11.1 cm; CON, 115.8 ± 9.2 cm; P = .054) and PL (CAI, 104.4 ± 8.7 cm; COP, 108.3 ± 11.5 cm; CON, 112.1 ± 8.6 cm; P = .065) directions.

CONCLUSIONS: Individuals with CAI but not Copers showed dynamic postural control deficits when performing the YBT compared to healthy controls. This could be due to reduced dorsiflexion range of motion or knee and hip flexion as commonly seen in individuals with CAI. These results further provide evidence of residual postural control deficits in individuals with CAI even many years after injury. Whether the origins of these deficits are peripheral or central needs to be determined.

CLINICAL RELEVANCE: Results of the current study are similar to those observed with using the SEBT for persons with CAI. Clinicians providing rehabilitation to persons with CAI may use YBT for assessing dynamic postural control given its excellent interrater reliability and differences compared to those without CAI.

COMPARISON OF THE RELIABILITY OF THE VERTICAL GROUND REACTION FORCES DURING THE SINGLE-LEG HOP TEST FOR DISTANCE AND THE ALTERNATING-LIMB CROSSOVER HOP TEST FOR DISTANCE IN NORMAL SUBJECTS

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PURPOSE/HYPOTHESIS: The single-leg hop test (SLHT) for distance is the gold standard in measuring functional dynamic knee performance. The purpose of this study was to devise a test utilizing hopping from one limb to the contralateral limb, termed the alternating-limb crossover hop (ALCH) test, which will be compared to the SLHT for distance for reliability using vertical ground reaction forces (vGRFs) produced during the take-off and landing phases. The ALCH test mimics functional activities such as walking, running, and cutting, by utilizing a reciprocal steppage pattern in comparison to the SLHT which only utilizes a single limb. Our hypothesis was vGFR produced during the ALCH test in normals will be similar to those produced during the SLHT.

NUMBER OF SUBJECTS: Sixty-five.

MATERIALS/METHODS: Sixty-five participants (37 female, 28 male; mean ± SD age, 23 ± 3.1 years) were allocated to either a normal (n = 50) or AKP group (n = 15) based on their subjective and objective clinical presenta-
Subjects performed a standardized dynamic lower extremity warm-up, followed by 8 randomized hops: right to right take-off, right to right landing, left to left take-off, left to left landing, right to right take-off, right to left landing, left to right take-off, left to right landing. Subjects performed each hop 2 times maximally, with a 30-second rest period between hops, while an AMTI OR6 force plate (AMTI Force and Motion) recorded vGFRs. We then had 20 normal subjects return for test-retest reliability for both, since this was the first time reliability of vGFRs were evaluated.

RESULTS: The vGFRs between the SLHT and the ALCH were not significantly different (P = .726, d = 0.051), nor were there any significant differences between the take-off and landing phases (P = .238, d = 0.25) across the SLHT and the ALCH test in normal subjects. ICCs were calculated. SLHT propulsive phase of left leg (ICC = 0.929), SLHT propulsive phase of right leg (ICC = 0.832), ALCH propulsive phase (ICC = 0.936), ALCH landing phase (ICC = 0.636).

CONCLUSIONS: This is the first study that has documented the reliability of the VGRFs of SLHT and ALCH. The SLHT for distance, the gold standard, is a valid, reliable, and practical way to help clinicians determine a patient’s readiness to return to activity. Since the SLHT and ALCH test were not significantly different, we conclude the ALCH test is also a valid dynamic lower extremity functional test to determine return to play and perhaps more functional because it replicates the gait cycle.

CLINICAL RELEVANCE: Due to the lack of significant differences between the SLHT and ALCH test, clinicians can utilize the more functional ALCH test to help determine return to activity because it has demonstrated good reliability for most of the tests.

**REFERENCES:**


**DISCUSSION:** The results of this case report suggest that combination electrical dry needling and cervical joint mobilizations can be an effective intervention for the treatment of CHA.

**PREFERENCE/HYPOTHESIS:** Up to 95% of dancers sustain at least 1 injury every year. Most injuries sustained by female ballet dancers coincide with the time they commence dancing en pointe (standing on toes in pointe shoes at maximum ankle plantar flexion). A priori data were analyzed from a large national survey of ballet dance instructors and dancers who perform en pointe concerning overall training regimens and perceptions of related pain and injury, specifically, components used to determine pointe readiness as well as the utilization of physical therapists in prepointe screening. We hypothesized that there was no difference in (1) pointe readiness screening components and (2) utilization of physical therapists in pre-pointe screening between ballet schools for ballet dancers who dance en pointe.

**NUMBER OF SUBJECTS:** Number of responses: 202 (131 dancers, 71 instructors).

**MATERIALS/METHODS:** The IRB-approved survey was nationally distributed through snowball sampling, targeting ballet instructors and dancers en pointe. Study data were collected and managed using REDCap (Research Electronic Data Capture). REDCap is a secure, web-based application designed to support data capture for research studies. The top-ranked elements from the literature used to determine pointe-readiness were ranked by the respondents in order of importance, from 1 to 5. The Wong-Baker Faces Pain Rating Scale and a frequency scale were used to report perception of dance-related pain. Data were analyzed using descriptive statistics.

**RESULTS:** Top-ranked tests for pointe readiness were: manual muscle strength testing (greater than 50%), ankle joint range of motion (29%), and dancers’ age (20%). Less than 1% identified either performance of dance-specific techniques (eg, alignment of plié, relevé or tendu), present injury status, or years in dance as the top-ranked factor. Eight-seven percent of instructors reported that they decided pointe readiness; 9% reported physicians determined pointe readiness; and 4% use “other” personnel (eg, head ballet mistress). No dance instructors reported physical therapists determine pointe readiness. Interestingly, dancers reported similar results, except that 1.5% reported a physical therapist was involved in screening.
CONCLUSIONS: Pointe readiness components varied widely nationally. There is a paucity of evidence to determine pointe readiness as well as an absence of utilization of licensed personnel, specifically physical therapists, who determine pointe readiness in this vulnerable population.

CLINICAL RELEVANCE: There is an extreme underutilization of physical therapists serving this young, developing cohort of performing artists. Implications are that physical therapists need to develop specialized skills and establish evidence-based factors that are important in determining pointe readiness. Screening tools must be developed for young dancers for pointe readiness like established for sport-specific areas (eg, baseball).

HIP ADDUCTORS ARE BILATERALLY STRONGER IN FEMALES WITH BILATERAL PATELLOFEMORAL PAIN COMPARED TO UNILATERAL PATELLOFEMORAL PAIN

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PURPOSE/HYPOTHESIS: Hip external rotation strength and hip adductor strength correlate with valgus collapse in females with patellofemoral pain (PFP). Studies that include hip adductor strength often find strength differences compared to controls; but few studies examine the relationship between hip adductor strength and valgus collapse. Valgus collapse can be measured clinically using a frontal plane projection angle (FPPA). The purpose of our investigation was to determine if (1) hip adductor weakness is present in females with PFP, (2) hip adductor differs in females with unilateral versus bilateral PFP, (3) hip adductor weakness correlates with FPPA.

NUMBER OF SUBJECTS: Females with unilateral PFP (n = 9; mean age, 21.1 years; BMI, 21.9 kg/m²; KOS-SAS, 78%), females with bilateral PFP (n = 12; age, 21.3 years; BMI, 23.4 kg/m²; KOS-SAS, 76%), and controls (n = 20; age, 21.3 years; BMI, 23.4 kg/m²; KOS-SAS, 98%).

MATERIALS/METHODS: Females were at least 18 years old and had unilateral or bilateral PFP. Females were excluded if they have a history of injury or surgery to the hip, groin, ankle, low back, or sacroiliac region. Isometric hip adductor, abductor, and external rotator strength was tested on both limbs with a hand held dynamometer. FPPA was measured with a digital image application during a single limb squat to 45°. ANOVA and correlation was used for analysis (P < 0.05).

RESULTS: Females with unilateral PFP were weaker in all muscle groups on the involved limb compared to the uninvolved limb and compared to controls (P < 0.05); the uninvolved limb was no different compared to controls (P > 0.05). Females with bilateral PFP demonstrated no side-to-side differences in muscle strength (P > 0.1); however, compared to controls, females with bilateral PFP had bilaterally stronger hip adductors (P < 0.031). The external rotator (P > 0.2), and abductor (P > 0.43) strength of females with bilateral PFP were not significantly different compared to controls. Controls demonstrated no side-to-side differences in muscle strength (P > 0.36). In persons with unilateral and bilateral PFP, the FPPA was not significantly (P > 0.06) correlated with external rotator (r = 0.49), abductor (r = 0.33), and adductor strength (r = 0.55).

CONCLUSIONS: Differences in adductor strength may depend on unilateral or bilateral PFP. Females with bilateral PFP had bilaterally stronger hip adductors. Females with unilateral PFP have unilaterally weaker hip adductor strength. The studies that combine persons with unilateral and bilateral involvement, and genders, often find no significant differences in hip adductor strength; or some investigations only look at persons with unilateral or bilateral involvement only. The mechanism behind difference in strength depending on limb involvement is unclear, and requires additional investigation.

CLINICAL RELEVANCE: The clinical relevance of hip adductor strength is unclear in females with PFP. Based on the data presented, strengthening hip adductors in conjunction with the external rotators and abductors, may be indicated in females with unilateral PFP.

OPO279

THE EFFECT OF ELECTRICAL STIMULATION CUING AND EXERCISE ON SCAPULAR POSITION IN A PATIENT WITH SCAPULAR DYSKINESIS AND SHOULDER PAIN: A CASE STUDY

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BACKGROUND AND PURPOSE: Altered scapular motion and position, termed scapular dyskinesia, is commonly treated in physical therapy clinics and is often a component of shoulder pain. Conventional therapeutic exercise programs to treat dyskinesia address impaired muscle recruitment in an effort to normalize scapular-humoral rhythm. Treatment durations can range up to 12 visits with varying success. There are no studies that examine therapeutic exercise with the addition of triggered electrical stimulation (ES) as a scapular repositioning cue to address shoulder pain and scapular dyskinesia. Walker et al found a within group difference in thoracic spine to scapula distance (TSS) at 120° of abduction with electrical stimulation combined with low upper trapezius to high lower trapezius ratio exercises (ESTherex). The purpose of this case report was to document the potential benefits of ESTherex added to manual therapy in the treatment of shoulder pain and scapular dyskinesia.

CASE DESCRIPTION: The patient was a 22-year-old male college student with a 10-year history of right lateral shoulder pain, elbow popping, and numbness and tingling (N/T) in the fourth and fifth fingers. The patient received 2 trials of traditional physical therapy lasting 2 months, multiple diagnostic exams including MRI, X-ray, and NCV, without improvement. The patient’s goal was to avoid exploratory right shoulder arthroscopy, and to continue power lifting. The patient received 6 treatments of ESTherex and 4 manual therapy sessions. Electrical stimulation cueing was provided via a handheld switch. A biphasic-pulsatile current was used. The frequency and pulse-width were 25pps and 250 microseconds, respectively. The intensity produced scapular retraction.

OUTCOMES: Pain intensity decreased on the numeric pain-rating scale from 9/10 to 0/10 at rest. The patient’s complaints of N/T in the right fourth and fifth fingers were resolved. Right shoulder PROM was returned to 100% from flexion of 165°, abduction 155° and horizontal abduction to midline. The QuickDASH disability score improved from 38.6% disability to 2.27%. The QuickDASH work module score improved from 6.6 to 0, the QuickDASH sport module score improved from 37.5 to 0. The Patient-Specific Functional Scale (PSFS) average score improved from 3.7 to 8.3. Individual PSFS score improvements were as follows: power lifting from 4 to 8, sleeping supine from 4 to 9, “left side lying flexibility” from 3 to 8.Thoracic spine to scapula distance differences were noted at the following shoulder abduction angles: −0.7 cm at 0°, −0.1 cm at 45°, 0.4 cm at 90°, and −0.5 cm at 120°.

DISCUSSION: The addition of electrical stimulation combined with low upper trapezius to high lower trapezius exercises, to traditional manual therapy, resulted in improvement in multiple outcome measures and a change in TSS distance at various angles of scapular abduction in a patient with shoulder pain and scapular dyskinesia.

THE LONG-TERM EFFECTS OF ECCENTRIC EXERCISE VERSUS EXTRACORPOREAL SHOCKWAVE THERAPY IN ATHLETES AGED 18 TO 50 YEARS WITH PATELLAR TENDINOPATHY: A META-ANALYSIS AND SYSTEMATIC REVIEW

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PURPOSE/HYPOTHESIS: Patellar tendinopathy is a highly prevalent orthopaedic condition among both recreational and elite athletes.1 In elite volleyball and basketball athletes, prevalence rates have been reported as high as 45% and 32% respectively.2 It is therefore important to compare the efficacy of new physical therapy interventions for PatT such as ESWT with popular interventions such as EE. Recent systematic reviews have recommended both EE and ESWT for use in this population, however no studies have directly compared the 2 interventions in athletes with PatT.3,4 The purpose of this study was to compare the long-term effects of eccentric exercise (EE) on pain and function to those of extracorporeal shockwave therapy (ESWT) in athletes with patellar tendinopathy (PatT). It is hypothesized that EE will result in a greater treatment effect than ESWT for both reducing pain and improving function.

NUMBER OF SUBJECTS: Search procedures followed Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines using the PubMed, CINAHL, and Cochrane Library databases. Inclusion criteria consisted of: athletes aged 18 to 50 years, PatT for greater than 3 months, EE, ESWT, visual analog scale (VAS) measuring pain, Victorian Institute of Sport Assessment-patella (VISA-P) measuring function MATERIALS/METHODS: Means and standard deviations for both the VAS and VISA-P outcome measures were imported into the OpenMeta[Analysis] software program, and a fixed-effects model used to calculate effect sizes based on a 95% confidence interval. A separate systematic review was conducted on athletes with lower extremity tendinopathies, including PatT and Achilles tendinopathy (AT).

RESULTS: The meta-analysis found EE to be superior to ESWT for both decreasing pain (ES, 2.363; 95% CI: 1.075, 3.651; P = .692; Q, 0.157) and improving function (ES, 18.790; 95% CI: 8.604, 28.977; P = 18.790; Q, 1.562). The systematic review found strong evidence to support the use of EE for AT, moderate evidence in support of EE and ESWT individually for PatT, and weak evidence in support of ESWT for AT.

CONCLUSIONS: The results confirm the alternative hypothesis and reject EE over ESWT but do not refute the null. Eccentric exercise is more effective than ESWT at addressing PatT symptoms in the athletic population. Both interventions are effective for athletes with PatT or AT.

CLINICAL RELEVANCE: Physical therapists should prescribe EE, using the Alfredson protocol,5 first for athletes with PatT. Extracorporeal shockwave therapy is a viable secondary treatment option for patients that fail to respond to eccentric alone. As more evidence arises in support of its efficacy, the use of ESWT seems to be increasing in US physical therapy clinics.

AN ALGORITHMIC APPROACH TO CONCUSSION REHABILITATION: A CASE SERIES

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BACKGROUND AND PURPOSE: Until recently, rest was the treatment method of choice for concussion.6 While some level of rest is beneficial to offset the metabolic crises of the initial injury, prolonged rest can lead to physical deconditioning,6 metabolic disturbances7 and secondary symptoms including depression and excessive fatigue.8 However, current research is lacking appropriate intensity, frequency, duration and mode of exercise for these individuals due, in part, to the variability of presentation. This case series introduces an algorithmic approach to concussion rehabilitation that proposes an exercise progression based on symptom presentation and level of irritability that is tailored to each individual patient.

CASE DESCRIPTION: Twelve patients were seen in an outpatient physical therapy setting from July 2016 to May 2017 for treatment of concussion. The patients ranged in age from 9 to 34 years. Time between concussion onset and initiation of physical therapy intervention ranged from 2 days to 6 months. Eight of the 12 individuals sustained his or her concussion during an athletic event, 1 due to a fall and 2 due to a motor vehicle accident.

OUTCOMES: All patients demonstrated cervical, vestibulo-ocular and balance impairments on initial evaluation. Cervical impairments were assessed by range of motion and report of neck pain at rest or with movement. Average numeric pain rating scale (NPRS) on intake was 4.5. Vestibulo-ocular impairments were assessed using the Vestibular Oculo-Motor Screen (VOMS) with a mean of 4.4 positive domains. Balance was assessed using the Balance Error Scoring System (BESS) with an average of 27.5 errors. Finally, a functional self-assessment was performed using the Focus on Therapeutic Outcomes (FOTO) survey with a mean score of 66.1, indicating moderate impairment. Upon completion of initial evaluation, a 5-stage rehabilitation algorithm was initiated. The algorithm included 4 subcategories to address cervical, vestibulo-ocular, balance and functional impairments at discharge. Each individual was able to return to school, sport or work activities without reported limitation. The outcomes of this case series suggest that the use of an algorithmic approach may be beneficial in treating individuals with concussion, though more research is needed to validate these findings.

MECHANICAL LOW BACK PAIN IN ADOLESCENTS: A CASE SERIES

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BACKGROUND AND PURPOSE: Low back pain (LBP) is an increasing problem in health care. Physical therapy has been proven to be beneficial for the treatment of LBP. A clinical prediction rule (CPR) for treating mechanical LBP with lumbar manipulation has been established and validated for the adult population. While most view low back pain as a concern for adults, it is highly prevalent in children as well. The evidence is nearly nonexistent for using spinal manipulative therapy (SMT) to treat children with low back pain. The treatment of children with manual therapy, particularly spinal manipulation, is controversial within the medical community primarily with respect to adverse events. The purpose of this case series is to illustrate the effectiveness and safety of lumbar manipulation plus exercise in the adolescent population (12-17 years of age) with mechanical LBP.

CASE DESCRIPTION: Three patients between the ages of 13 and 15 were treated in an outpatient physical therapy setting for mechanical low back pain. Symptom onset ranged from 2 weeks to 2 months prior to date of initial examination. No red flags or contraindication to manipulation were observed. Two of the patients were positive on 4 of 5 CPR criteria and 1 was positive on 3 of 5. Patient were also evaluated for lumbar mobility and quality of movement and reflexes. All 3 patients were treated with sidelying lumbar manipulation and exercise. All patients experienced immediate decrease in pain following initial lumbar manipulation. Manipulation was utilized at the beginning of each session until further objective and subjective changes were no longer observed. Exercise was progressed based on intensity and irritability. Focus of exercise progressed from motor control, to muscle endurance, to muscle hypertrophy, and finished with strength and power throughout the plan of care.

OUTCOMES: Patients were treated for a total of 10 to 14 visits over a course of 8 to 9 weeks. Manipulation was performed 8 to 13 visits. Pain, as measured by the numeric pain-rating scale, and disability, measured by the Modified Oswestry Disability Index, ranged from 5 to 8/10 and 14% to 38% respectively at the onset of treatment. All 3 patients improved to 0/10 pain and 0% disability by the end of the plan of care. Patient demonstrated improved lumbar mobility and quality of movement and normalized reflexes. All patients returned to their respective sports by the end of treatment. No adverse reactions to manipulation were reported or observed.

DISCUSSION: The results of this case series demonstrate lumbar manipulation and exercise are potentially beneficial for the treatment of mechanical low back pain in adolescents. Conclusions about effectiveness cannot be made as this is a case series without a control. The successful treatment of these patients warrants further research into the effectiveness of lumbar manipulation, both independently and in conjunction with exercise, for the treatment of adolescents with mechanical low back pain.

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BACKGROUND AND PURPOSE: The PT plays a critical role as a musculoskeletal screener on the multidisciplinary health care team. Many patients with LBP will present to a PT having had lumbar imaging. Clinicians may rely on imaging to guide treatment, despite being able to identify a pathoanatomical cause of a patient's LBP in only 15% of cases due to incidental findings.1-4 The following case demonstrates the vital role of the PT in effective musculoskeletal screening and assessment of a patient with evolving low back pain and imaging findings of facet arthropathy.

CASE DESCRIPTION: A 36-year-old woman presented to physical therapy with lumbar radiculopathy upon referral from physical therapy after a motor vehicle accident. Patient demonstrated a positive straight leg raise and peripheralization of symptoms into the right calf with lumbar flexion that centralized with lumbar extension. Functional limitations included inability to sit greater than 10 minutes and inability to walk greater than 1 mile. Patient reported pain rated 7/10 and scored 27 on the Patient-Reported Outcomes Measurement Information System (PROMIS), indicating moderate disability. Patient was treated for 6 visits over 8 weeks with an extension-based program resulting in centralization of symptoms out of the leg with decreased pain (3/10) and disability (PROMIS, 34).5 One month later, however, the patient again developed similar symptoms radiating into right thigh that were now unresponsive to extension-based interventions. The referring provider recommended radiography examination (RFA) for treatment of lumbar facet arthropathy, which had been diagnosed by radiographic evaluation. However, examination was no longer consistent with pain of lumbar etiology. Patient demonstrated normal lumbar range of motion with unremarkable neural tension testing. Instead, examination revealed signs of right sacroiliac joint dysfunction (SLID) per Laslett criteria.6

OUTCOMES: Consultation with the referring provider emphasized that the patient's presentation was inconsistent with lumbar facet arthropathy and would be unlikely to respond to lumbar nerve RFA. Despite this recommendation, the patient underwent the procedure without change in symptoms. Physical therapy interventions for management of SLID provided short-term relief, but as the patient continued to be symptomatic, the PT recommended RFA at the sacral level. The patient underwent SI-3 RFA with 80% resolution of symptoms and return to prior functional status.

DISCUSSION: This case highlights the important role of the PT as a musculoskeletal screener in complex and evolving clinical presentations. The expertise of the PT in physical examination and differential diagnosis can assist physicians in appropriately directing medical interventions such as RFA procedures. In this case, an evidence-based examination that included a cluster of tests was useful in identifying the joint of dysfunction in the presence of asymptomatic radiographic abnormalities of the lumbar spine.


OPO284
DOES TACTILE FEEDBACK INCREASE LUMBAR MULTIFIDUS MUSCLE ACTIVATION IN ASYMMETRIC HEALTHY ADULTS AND PATIENTS WITH LOW BACK PAIN?
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PURPOSE/HYPOTHESIS: Decreased lumbar multifidus (LM) muscle function has been found in patients with low back pain (LBP). Considerable evidence supports the use of spinal stabilization exercises for treating LBP, including exercises for activating the LM muscle. Therefore, specific LM muscle training is a routine part of rehabilitation programs for treating LBP. Clinicians often use various strategies to ensure LM activation, including tactile feedback and verbal instruction. Various verbal instructions have been shown to increase LM thickness in ultrasonographic imaging studies. However, the effects of tactile feedback on muscle activation have not been studied previously. Therefore, the purpose of this study was to investigate whether or not tactile feedback would increase LM muscle activity in adults with and without LBP.

NUMBER OF SUBJECTS: Twenty asymptomatic adults (9 men, 11 women; mean ± SD age, 31.7 ± 10.5 years) and 20 patients with existing LBP (7 men, 13 women; age, 36.7 ± 18.7 years) completed the study.

MATERIALS/METHODS: Two sets of surface electrodes were applied to both sides of the LM muscles, approximately 2 to 3 cm from the L5 spinous process. First, surface electromyographic (EMG) activity was collected 3 times for 5 seconds at rest with and without tactile feedback. Next, EMG activity was collected 5 times, each for 8 seconds, during contralateral arm lifts with and without tactile feedback. The tactile feedback was applied by direct and continuous hand contact to the bilateral LM over the lumbar paravertebral muscle. Last, two 5-second trials of maximum voluntary isometric contraction (MVIC) during a unilateral arm lift were performed. EMG activity collected at rest and during contralateral arm lifts was normalized to that collected during MVIC. Normalized EMG values of the right side of the asymptomatic group and the painful side of the LBP group were used for data analysis. Upon completion of EMG recording, participants were asked to indicate whether or not tactile feedback was useful to help them to contract the LM muscle.

RESULTS: Statistical analysis showed significantly decreased LM EMG activity with tactile feedback both at rest (P = .013) and during contralateral arm lifts (P = .010) compared to LM EMG activity without tactile feedback. There was no difference in LM EMG activity between groups. Interestingly, 7 asymptomatic participants and 10 patients with LBP perceived hand contact to be helpful for activating the LM muscle.

CONCLUSIONS: The results of the study showed that the application of tactile stimulation appeared to result in an inhibitory effect on LM muscle activity in both asymptomatic healthy adults and patients with LBP. Rather than producing a facilitating effect, tactile feedback may produce a relaxation effect on LM.

CLINICAL RELEVANCE: Contrary to common belief, tactile feedback via direct hand contact may reduce LM muscle recruitment, and may lessen the desired treatment effect.

OPO285
PSYCHOLOGICALLY INFORMED PRACTICE TRAINING CHANGES PHYSICAL THERAPISTS' ATTITUDES AND BELIEFS ABOUT CHRONIC PAIN
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P = .

The aim of this study was to determine the acute effects of moderate intensity lower extremity aerobic exercise in patients with chronic lower back pain (LBP). We hypothesized that PIP training would shift PTs’ treatment orientation from a biomedical toward biopsychosocial one.

**NUMBER OF SUBJECTS:** Twenty PTs participated in the study. Seven acted as control PTs and received no PIP training (CON-PTs). The remaining 13 PTs (PIP-PTs) attended a 5-day course on PIP.

**MATERIALS/METHODS:** Twenty PTs completed the Pain Attitudes and Beliefs Scale for Physical Therapists (PABS-PT) questionnaire; 2 scores were derived to reflect their biomedical and biopsychosocial treatment orientation. The 13 PIP-PTs repeated the PABS-PT questionnaire following the training. The PIP training covered topics such as pacing and grading activities to increase/ maintain activity, and understanding chronic pain and its impact on patient functioning. T-tests were used to compare the scores between the CON-PTs (n = 7) and PIP-PTs (n = 13).

**RESULTS:** Prior to training, the CON-PTs and PIP-PTs had similar biomedical orientations (P = .46); however, the CON-PTs had a stronger biomedical orientation (P = .02). Following PIP training, the PIP-PTs’ biopsychosocial orientation increased significantly (P = .003), and their biomedical orientation decreased significantly (P < .001) compared to pretraining scores. As expected, PIP training shifted the PTs toward a biopsychosocial treatment orientation. Previous studies using the PABS-PT questionnaire report an average biomedical score of 50.5 ± 7.9 (our average was 29.7 ± 6.9) and an average biopsychosocial score of 34.1 ± 4.1 (our average was 35.7 ± 4.9).6 Following PIP training, Jacobs et al. showed a decrease in their biomedical score of 4.92 (our decrease was 9.0) and an increase in biopsychosocial score of 4.2 (ours was 6.6).7

**CONCLUSIONS:** An intensive 5-day training course is effective in decreasing PTs’ biomedical orientation and increasing their biopsychosocial orientation and can provide PTs with unique tools to treat chronic pain.

**CLINICAL RELEVANCE:** Worldwide LBP is the greatest cause of disability and missed workdays.8 While no one specific treatment has been shown to be effective, the use of PIP has been shown to improve outcomes for chronic LBP.4,9 Our data demonstrate the success of PIP training and its ability to change PTs’ treatment orientations and point to the need for greater availability of PIP training opportunities. With greater numbers of PTs who incorporate biopsychosocial principles into treatment of patients with chronic pain, there is more potential for improved patient outcomes for chronic LBP.

**CORTICOSTEROID INJECTIONS PERFORMED BY A PHYSICAL THERAPIST:**

**OPO287**

**A REVIEW OF 5 CLINICAL CASES**

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**BACKGROUND AND PURPOSE:** In the US military, physical therapists may obtain advanced credentials, through additional training, which may include the use of corticosteroid injections. While corticosteroid injections have mixed effects,10-12 with the physical nature of many occupations there may be benefits in the military. Due to operational requirements and deployments, some patients do not have the ability to perform adequate conservative care. The purpose of this session is to review 5 clinical cases and highlight the clinical decision making involved with corticosteroid injections performed by a physical therapist.

**CASE DESCRIPTION:** Patient 1, aged 42 years, was a competitive weightlifter who was diagnosed with a superior labral anterior to posterior tear via magnetic resonance imaging by his primary care physician. Clinical examination indicated acromioclavicular joint dysfunction; radiographs confirmed moderate osteoarthritis of the acromioclavicular joint. Patient 2, aged 25 years, had a history of grade 2 acromioclavicular sprain while in high school. His symptoms were exacerbated with repetitive overhead work as a fuels technician 2 months into a 6-month deployment to the Middle East. Patient 3, a female pharmacist, aged 39 years, complained of a more than 2-year history of subacromial pain with overhead activities that was exacerbated during a deployment to the Middle East. Patient 4, a male special forces soldier, aged 37 years, was 4 years from a biceps tendinitis with continued lateral shoulder pain that was exacerbated after a training event prior to a deployment to the Middle East. He was evaluated by a physical therapist prior to his deployment and given a home exercise program, but did not improve. He was 4 months into a 9-month deployment. Last, patient 5, a 44-year-old male fighter pilot with known bilateral tricompartamental knee osteoarthritis had an exacerbation of symptoms secondary to an increase in running. All patients received a diagnostic and/or therapeutic corticosteroid injection which were performed by a physical therapist in the US military.
OUTCOMES: Patient 1 had immediate relief of symptoms, completed a course of physical therapy, avoided surgery to repair the superior labral tear, and remained symptom free 12 months from the injection. Patient 2 had immediate symptom relief and completed a course of physical therapy, but became symptomatic again approximately 8 weeks following the injection. He subsequently underwent a distal clavicle excision 4 months after returning home from his deployment. Patients 3 through 5 had immediate symptom relief and remained asymptomatic 4 months later.

DISCUSSION: With training, physical therapists can provide diagnostic and therapeutic corticosteroid injections to patients both at home and while deployed. These 5 cases highlight safe usage of corticosteroid injections as performed by a physical therapist in the military.


OP0288
WEARABLE TECHNOLOGY MAY ASSIST IN RETRAINING FOOT-STRIKE PATTERNS IN PREVIOUSLY INJURED RUNNERS
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PURPOSE/HYPOTHESIS: A rearfoot strike pattern with increased vertical loading rates while running has been associated with injury. Biofeedback provided by a clinician is often used to transition an individual from a rearfoot strike to a non–rearfoot-strike running pattern. This is an effective strategy in healthy and previously injured runners when performed during 8 to 18 in-clinic visits over 2 to 6 weeks with the transition maintained at a 1-month follow-up.1,4 However, when clinicians provide biofeedback in-clinic for rehabilitation, the total medical care costs increase. The purpose of this study was to assess the ability of a commercially available instrumented sock, which provides real-time foot strike and cadence feedback, to elicit ground reaction force data. If a transition to a non–rearfoot-strike running pattern occurred, the subject stopped using the instrumented socks and returned for a final ground reaction force data collection.

RESULTS: Nearly all (18/19) transitioning to a non–rearfoot-strike (mean ± SD, 8 ± 2.36 weeks) and 5 weeks later (mean ± SD, 4.98 ± 0.79 weeks), the majority (16/18) maintained the transition. Average vertical load rate decreased between the initial (54.80 BW/s; 95% CI: 48.61, 60.79) and the non–rearfoot-strike collections (38.97 BW/s; 95% CI: 34.36, 43.58; P = .002). This effect persisted 5 weeks later (46.95 BW/s; 95% CI: 34.27, 54.68; P = .024). Cadence increased from the initial (168.51 steps/min; 95% CI: 164.95, 172.08) to the non–rearfoot-strike collection (173.30; 95% CI: 170.30, 176.30; P = .045), however this effect did not persist at 5-week follow-up (171.57; 95% CI: 168.28, 174.86; P = .08).

CONCLUSIONS: With technology provided foot strike and cadence feedback, approximately 90% of subjects transitioned to a non–rearfoot-strike running pattern, decreased average vertical loading rates, and maintained 5 weeks later.

CLINICAL RELEVANCE: This is the first study that relied solely on technology to provide foot strike pattern feedback to the participant outside of the clinic in recovering injured runners. There may be a substantial time savings over in-clinic care provided by a clinician while decreasing future re-injury, lost work time, and medical costs.

OP0289
COMPETITIVE COLLEGIATE DANCE TEAM INJURIES: A PROSPECTIVE STUDY
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PURPOSE/HYPOTHESIS: The purpose of this study was to examine dance injury epidemiology, including incidence, mechanism, and anatomical locations, as well as to identify predictors of injuries sustained in competitive collegiate dancers which will aid clinicians who work with dancers. Our hypothesis was that injuries would be comprised mainly of strains and sprains of the foot and ankle.

NUMBER OF SUBJECTS: A convenience sample of 21 subjects completed the study and were monitored for injury over 8 months. All subjects were formal members of the official Western Carolina University Dance Team.

MATERIALS/METHODS: Throughout the 8-month dance season, injury rates of the dance team were collected using the online survey engine Qualtrics. A Qualtrics survey was filled out every time a dancer sustained an injury during dance related activity. Dance hours were determined by tracking total practice and performance hours throughout the competitive season. Injury incidence rate was calculated using number of prospective injuries and total dance hours. Once an injury was sustained, the subject underwent a clinical assessment within 1 to 2 days of injury occurrence.

RESULTS: Eleven injuries occurred to 9 dancers; 5 of these injuries were recurrent with the initial injury occurring prior to the beginning of the study period. Of the 11 injuries, 7 involved the LE; specific locations of injury included: ankle (5/11, 45.5%), knee (1/11, 9.1%), thigh (1/11, 9.1%), low back/pelvis (2/7, 18.2%), shoulder (1/11, 9.1%), and head (1/11, 9.1%). All 11 of the injuries reported resulted from nonperformance activities. Known mechanisms of injury throughout the dance season included warm-up/running (2/16, 12.5%), strength training (2/16, 12.5%), leap/jump/landing (4/16, 25%), lift/partner/landing (2/16, 12.5%) practicing skill (1/11, 6.3%), and turning (2/16, 12.5%). Due to the complex nature of dance performance, multiple mechanisms of injury could result in a single injury. Throughout the dance season, the team danced a total of 8057.25 hours. Injury incidence rate was therefore calculated to be 1.37 injuries per 1000 hours of dance (11 injuries/8057.25 hours). Significant differences identified between injured and noninjured dancers as determined by independent-samples t test included (for injured dancers) reduced dynamic balance (SEBT left anterior and right posterior medial, P < .05), bilaterally reduced gastroc-soleus muscle performance (max heel
raise repetitions, P < 0.05), and higher score on an eating disorder screening questionnaire (BEDA-QV2, P = 0.05).

CONCLUSIONS: In our cohort, collegiate team dancers reported a high proportion of lower limb injuries with ankle/foot injuries predominating. Significant differences between injured and noninjured dancers were found in dynamic balance, muscle performance and nutritional attitudes. CLINICAL RELEVANCE: There is a need to identify and implement preventive measures during nonperformance dance activities (practice, rehearsal, workouts, etc.) to reduce the risk of injury due to the high rate of injuries reported and concomitant loss of dance participation.

OP0290

QUALITY ASSURANCE: ALIGNMENT OF BACK PAIN TREATMENT WITH PRACTICE GUIDELINES

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PURPOSE/HYPOTHESIS: The burden of low back pain (LBP) is well described in the literature. Clinical practice guidelines (CPG) inform value-driven, evidence-based (EB) care that improves outcomes. Despite efforts to promote uptake of CPG into practice, there continues to be a knowledge to practice gap, with CPG discordant care leading to poor outcomes. Therefore, it is important to explore clinical practice in specific domains to identify alignment with the CPG. Within a multicenter hospital system, optimizing and standardizing care is vital for quality assurance. In this way, patients, clinicians and administrators are assured provision of EB care throughout the branded organization. The purpose of this 2-phase study was to (1) identify patterns of treatment recommendations (TR) relative to the CPG (concordant/discordant); CPG, CPGD for standardized patient-cases of LBP among physical therapists (PT) employed in an urban health care system (UHS); (2) investigate if clinician LBP beliefs predict practice behaviors when treating patients with LBP. This abstract represents Phase 1.

NUMBER OF SUBJECTS: Sixty-nine.

MATERIALS/METHODS: A cross-sectional study design was completed. Participation was anonymous and voluntary. An electronic survey platform was utilized for data collection. The survey included demographic questions, a LBP beliefs questionnaire and 6 validated vignettes describing typical LBP clinical encounters for acute, chronic or very chronic cases, with/without red or yellow flags (RF/YF), accompanied by a questionnaire with an exhaustive list of treatments in the domains of diagnostics, activity recommendations, therapeutic procedures, medication, referral to other services and education. Two widely accepted CPG were used to score TR as CPG/CPCGD.

RESULTS: Sixty-nine of 149 subjects participated (response rate, 46%; 60% female; 78% DPT), 59% having fewer than 10 years of clinical experience. Overall CPGD care was 32.3% (34.3% for yellow flag cases; 30.3% for red flag cases). Most CPGD care was in the domains diagnostic tests and therapeutic procedures (YF cases) and referrals (RF cases). This was most evident for acute and chronic cases.

CONCLUSIONS: Subject demographic data suggests likely exposure to CPG during clinical training, CPGD care was characterized by excessive therapeutic interventions and inappropriate referrals. The results suggest that PT tend to overmedicize LBP, and provide care that is not EB. Providing CPGD treatment is economically baseless, and may impede recovery or compromise the patient’s health. Therefore, targeted training is needed to translate research into paradigms of clinical care. The methods used allow for the identification of specific domains and patient groups where most treatment uncertainty lies. Further research may explore PT beliefs that drive clinical decision-making and typical clinical care for other patient subgroups.

CLINICAL RELEVANCE: This study provides new insights into identifying patterns of clinical care. Utilizing this information to develop targeted multimodal educational models may bridge the knowledge to practice gap.

OP0291

DO RUNNERS DEMONSTRATE LESS RISKY HIP AND KNEE KINEMATICS THAN NONRUNNERS DURING DROP VERTICAL JUMPS?

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PURPOSE/HYPOTHESIS: Running is a popular mode of exercise. While there is a high incidence of running related injuries, these injuries are less frequent in those with a longer history of running. The most commonly reported running injury is patellofemoral pain, which has been linked to aberrant drop vertical jump (DVJ) biomechanics that also predict anterior cruciate ligament injury risk. Despite this, little is known regarding DVJ mechanics in runners. Therefore, the purpose of this ongoing study was to compare DVJ kinematics associated with knee injury between runners and nonrunners.

NUMBER OF SUBJECTS: Thirty healthy individuals were tested. Runners qualified with a least 2 consecutive years of running experience at the time of testing. On average, runners (n = 23) were 23.7 ± 2.8 years old, with body mass index (BMI) of 23.7 ± 2.9 kg/m², a Tegner activity score of 5.3 ± 1.0, had been running 4.6 ± 0.7 years, and ran 7.4 ± 0.9 miles/wk. Nonrunners (n = 7) were 23.4 ± 1.4 years old, with BMI of 24.2 ± 2.3 kg/m², and with a Tegner activity score of 4.4 ± 1.1.

MATERIALS/METHODS: Subjects underwent instrumented motion analysis of a drop vertical jump task. Data were collected with a calibrated 8-camera Vicon system and 2 Bertec force plates. Subjects stood atop a 30 cm box and were instructed to drop onto the force plates and immediately perform a countermovement maximum vertical jump. Four usable trials were captured. Data were postprocessed and analyzed using Visual3D and custom LabVIEW software. Target variables included sagittal and frontal plane hip and knee kinematics associated with knee injury risk for both dominant and nondominant limbs. Data were statistically analyzed using a group-by-limb analysis of variance with an alpha level of 0.05 using Bonferroni adjustment.

RESULTS: There were no group differences based on age (P = .70), BMI (P = .69), or Tegner activity score (P = .09). No factorial interactions or dominant limb effects were seen. At initial contact, nonrunners’ knees were 5.0° more abducted than in runners (P < .001). For peak angles, nonrunners were 2.7° more abducted at the hip (P = .032) and 7.7° more abducted at the knee (P = .001) than in runners.

CONCLUSIONS: Nonrunners appear to exhibit kinematics associated with dynamic knee valgus to a greater degree than runners.

CLINICAL RELEVANCE: While not differing in age, BMI or activity levels, healthy nonrunners demonstrated riskier DVJ kinematics than runners, particularly in the frontal plane. The repetitive plyometric demands of consistent running may be associated with improved neuromuscular capacity that carries over to more dynamic tasks like the DVJ. Regular running may have a role in injury prevention. These preliminary and cross-sectional data suggest that incorporating regular running may be beneficial for individuals participating in cutting and jumping sports.

OP0292

LATERAL STEP-DOWN MOVEMENT QUALITY CORRELATES WITH HIP FRONTAL PLANE MECHANICS DURING DROP VERTICAL JUMP TESTING IN SUBJECTS WITH HISTORY OF ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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PURPOSE/HYPOTHESIS: While primary anterior cruciate ligament recon-
OPO293
IDENTIFICATION OF A LIPOMA IN A PATIENT WITH SHOULDER PAIN AFTER A MOTOR VEHICLE ACCIDENT: A CASE REPORT
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BACKGROUND AND PURPOSE: Proper physical therapy (PT) screening of patients with upper quarter complaints is essential for identifying signs and symptoms of nonmusculoskeletal pathology requiring referral. A lipoma is a benign fatty mass, often located in the posterior neck region that affects nearly 1% of the general population. Lipomas can affect adjacent tissues leading to pain, muscle atrophy, sensation changes, and functional loss. Early identification of a lipoma can lead to timely surgical intervention. The purpose of this case study was to describe the screening process of a patient referred to PT for left shoulder pain and found to have contributing signs and symptoms from a lipoma.

CASE DESCRIPTION: The patient was a 59-year-old man referred to PT by his primary care physician for left shoulder pain following a motor vehicle accident (MVA). The MVA occurred 21 days prior to the PT evaluation. At the initial visit, the patient complained of a heaviness feeling in the arm and constant pain in the upper left shoulder that increased with use. The patient also demonstrated decreased cervical range of motion (ROM) and grip strength. A positive upper limb tension test and cervical spine compression/distraction test, and involved side cervical rotation ROM less than 60° suggested a diagnosis of cervical radiculopathy. Neurological findings included an absent C7 deep tendon reflex and diminished sensation in the C7-T1 dermatomes. On observation, a 5.5 cm subcutaneous mass was located in the left posterior neck region 6 cm lateral from the C6 spinous process.

OUTCOMES: The patient proceeded with PT for management of cervical radiculopathy and referred to his primary care physician for the identified subcutaneous mass. A computed tomography scan was performed, which informed a physician diagnosis of a lipoma. The lipoma was excised due to size, location and contributing symptoms. After the 6-week PT intervention, the patient demonstrated improvements in all outcome measures. The patient reported reductions in disability (Disabilities of the Arm, Shoulder and Hand Score [0-100]; baseline, 31.25; follow-up, 6.82) and pain (numeric rating scale [0-10]; baseline, 6; follow-up, 2), and improvements in function (Patient-Specific Functional Scale [0-10]; driving: baseline, 3; follow-up, 7; computer work: baseline, 4; follow-up, 9; sleeping: baseline, 2; follow-up, 6). There was an increase in left grip strength (dynamometer: baseline, 42 psi; follow-up, 64 psi). The patient reported a final global rate of change of +7 indicating the patient was “a very great deal better.”

DISCUSSION: This case report described the PT evaluation process used for identification of a lipoma, subsequent referral, and successful PT and medical management. Screening of patients with upper quarter complaints should include consideration of the potential involvement of a lipoma and the need for medical referral.

yis. Additionally, 3 more subjects in the experimental group were identified as outliers during data analysis and eliminated. The control group received no training. The experimental group completed progressive scapulothoracic gyroscopic training using the Dynamax Core Trainer 2 times per week for 8 weeks. Each week, there was a standardized gradual increase of training time using the OMNI Scale Weekly Progression. Training involved 4 repetitions of 80% maximum effort for 45 seconds with a 2-minute rest break between each repetition. The duration of training was increased each week by 15% of the previous week’s repetition time, with a maximum training time of 2 minutes and 1 second. A final fatigue repetition of 100% maximum effort was completed at the end of each training session for as long as the subject could tolerate.

**RESULTS:** A 2-way mixed ANOVA applied to mean CKCUEST data revealed statistically significant improvements after training both within-subjects ($F_{1,64} = 0.015$, $P = .089$) and between-subjects ($F_{1,64} = 0.000$, $P = .234$). Due to high variability of SSP test data, paired sample $t$ tests were run on pretest and posttest mean differences instead of a 2-way mixed ANOVA. The SSP $t$ test also revealed statistically significant improvements in both dominant [$t = 3.25, P = .002$] and nondominant ($t = 3.58, P = .000$) extremities.

**CONCLUSIONS:** These results demonstrate that gyroscopic training improves scapulohumeral stability and upper extremity power.

**CLINICAL RELEVANCE:** With a growing number of gyroscopic devices being marketed to consumers and clinicians, research is needed to assess their effectiveness. One of these devices, the Dynamax Core Trainer, has been shown to be effective for increasing scapulothoracic functional stability and upper extremity power. This shows that gyroscopic training may be a useful tool to augment the rehabilitation process of patients with upper extremity instability or power deficits.

**OP0295**

**MUSICIAN INJURY PREVENTION SCREENINGS IN A UNIVERSITY ON-SITE PHYSICAL THERAPY CLINIC**

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**PURPOSE:** It is estimated that the number of university level music students experiencing performance-related musculoskeletal injuries in the U.S. ranges from 75% to 88%.1 The vast majority of these injuries occur due to overuse. In an effort to address this, the National Association of Schools of Music (NASC) has stated that, “Institutions should assist students to acquire knowledge from qualified professionals and authoritative medical sources regarding the maintenance of professional health and prevention of performance injuries.”2 The purpose of this project is to describe a musician injury prevention screening program conducted by students in an entry-level Doctor of Physical Therapy (DPT) program in collaboration with the School of Music at the same institution.

**DESCRIPTION:** Instrumental and vocal musicians complete a brief medical screening form that included questions about practice time and past/current play-related musculoskeletal injuries. DPT students conduct static and active posture screenings examination of instrumental musicians both with and without their instruments. Static standing posture screen includes observation of anterior, posterior and lateral alignment. Instrumentalists are then asked to assume their typical seated or standing playing position with their instrument and posture is reassessed. Musicians are also asked to play their instruments in order to evaluate dynamic posture and playing mechanics. DPT students provide education regarding the importance of warm-up, stretching, taking breaks, posture/playing position and pacing activity to prevent overuse injury Vocal musicians’ posture is assessed in standing only. Vocal musicians receive education about core muscle strength to enhance appropriate breathing patterns and a review of diaphragmatic breathing exercises.

**SUMMARY OF USE:** Seventy-five to 90 students in the School of Music participate in the screening each year. Students who exhibit signs or symptoms of performance-related injuries are offered the opportunity to either self-refer to a local physical therapy clinic, the onsite physical therapy clinic or follow-up with their primary care provider. The screening reinforces and enhances information on overuse injuries provided by faculty in the School of Music regarding injury prevention. Through this experience, DPT students gain a better appreciation for the potential of injury among musicians and the similarities that exist between them and athletes who also often play through injuries. Although much of this information was not new, student musicians appreciate the education provided by the DPT students.

**IMPORTANCE TO MEMBERS:** Music is a rigorous field of study and the importance of education and healthy habits among musicians cannot be underscored. This experience provides DPT students with an opportunity to practice health screening and provide preventative education in a realistic setting.

**OP0296**

**RECRUITMENT OF THE TRANSVERSE ABDOMINIS DURING SELECTED THERAPEUTIC EXERCISES AS MEASURED BY REHABILITATION ULTRASOUND IMAGING**

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**PURPOSE/HYPOTHESIS:** To identify which therapeutic exercises, from a collection of exercises commonly-used in the management of LBP, are most effective in activating the TA. It was hypothesized that PNF and Planks would be more effective than other commonly used exercises.

**NUMBER OF SUBJECTS:** Thirty doctoral students between 18 and 25 years of age with no complaint of LBP.

**MATERIALS/METHODS:** RUSI probe was secured by a single investigator at a distance halfway between the right iliac crest and 12th rib along the anterior axillary line with the medial aspect of the probe 10cm lateral to the midsagittal plane. Prior to exercise, each subject demonstrated the ability to selectively recruit the TA through performance of the ADIM in prone and the image was captured. Each subject was then randomly assigned a sequence of 10 exercises performed alternately on either a stable or unstable surface for 3 reps each. Exercises included supine curl-up, quadruped right UE/left LE lift, prone plank, right-sided plank, and sitting PNF chop to the right. Muscle thickness of the TA was calculated using RUSI that was recorded on the third repetition of each exercise. A single investigator was used for each aspect of data collection and analysis of RUSI data, that compared MT of the TA during each exercise to MT of the TA during the ADIM and at rest, was performed in a blinded fashion.

**RESULTS:** Repeated-measures ANOVA revealed all exercises were significant predictors of TA thickness ($P < .05$). Bonferroni Post hoc tests revealed that stable/unstable chop, supine curl-up, and swimmer were all comparable to the ADIM ($P < .05$) and significantly better at recruiting the TA than stable/unstable prone planks and stable/unstable right-sided planks. Furthermore, the unstable PNF chop showed a significant main effect when compared to stable supine curl-up ($P < .005$), unstable supine curl-up ($P < .001$), stable swimmer ($P < .01$), and unstable swimmer ($P < .023$).

**CONCLUSIONS:** Based on these results the stable/unstable PNF chops, swimmer, and supine curl-up exercises are statistically comparable to the ADIM in regards to TA activation as measured by muscle thickness on RUSI. The unstable PNF chop revealed statistically better TA activation than the stable/unstable swimmer and supine curl-up exercises. Exercise regimens should incorporate stable/unstable PNF chops, swimmer, and supine curl-up exercises, but particularly the PNF chop exercise, when targeting the TA for spinal stability. In contrast, the inclusion of stable/unstable planks and right-sided planks should be reconsidered. Future research is needed to determine the efficacy of these exercises in individuals with LBP.
OPO297
FUNCTIONAL IMPROVEMENTS AFTER CONSERVATIVE POSTOPERATIVE MANAGEMENT OF A LISFRANC INJURY: A CASE REPORT
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BACKGROUND AND PURPOSE: A Lisfranc injury refers to damage of the ligaments and bones at the articulation of the tarsals and metatarsals. This injury is rare, with an occurrence rate of approximately 1 in 55,000. Accurate diagnosis is crucial, as a missed diagnosis can lead to long-term disability and poor prognosis. This case report describes the surgical protocol, the course of treatment through rehabilitation, the outcomes measured, and the functional improvements seen over a 16-month span after a traumatic Lisfranc injury.

CASE DESCRIPTION: The patient was a 23-year-old athletic woman who sustained a high velocity, traumatic Lisfranc injury in the right foot after a motor vehicle accident. She presented to the emergency department after sustaining right foot trauma. She had difficulty bearing weight due to a soft tissue injury. After initial negative findings with non-weight-bearing (NWB) radiographs, the patient was sent home, diagnosed with a “foot sprain.” After 2 weeks, the patient noticed a worsening of symptoms and sought a second opinion. Weight-bearing and NWB radiographs showed a right Lisfranc fracture and dislocation at the first and second tarsometatarsal joints. An open reduction internal fixation was performed 4 days later. Postoperatively, the patient was placed in a soft cast for 10 days for wound healing; followed by a Controlled Ankle Motion boot for 12 weeks NWB. The patient was then referred to and attended PT 2 times per week for 6 weeks. Interventions included: lower quarter strengthening, balance training, mobilizations of the talocural joint and surrounding soft tissues, and endurance training (e.g., stationary bike, treadmill walking and running).

OUTCOMES: The patient showed meaningful improvement in the following outcomes measured 12 weeks postoperatively (PRE), discharge of PT (MID) and 16 months postoperatively (POST): Lower Quarter Y Balance Test (YBT) composite scores, (right, left) (PRE: 86.8%, 94.9%; MID: 95.9%, 95.5%; POST: 95.4%, 94.6%) and anterior reach difference right versus left (PRE: 12.84 cm; MID: 7 cm; POST: 3 cm), gait speed at self-selected normal pace (PRE: 1 m/s; POST: 1.43 m/s), swing phase of gait at self-selected normal pace (right, left) (PRE: 42.6%, 35.5%; POST: 38.9%, 39.2%), stance phase of gait at self-selected normal pace (right, left) (PRE: 57.4%, 64.5%; POST: 61.1%, 60.8%), Lower Extremity Functional Scale (LEFS; PRE, 54/80; MID, 66/80; POST, 78/80). Additionally, the patient improved right lower extremity active dorsiflexion range of motion (PRE, −8°; MID, −4°; POST, 5°).

DISCUSSION: The patient showed improved functional balance on the YBT performance exceeding the 3.5% MCID from PRE to MID and POST. Dorsiflexion improved 13°, into a more functional range. The LEFS score improved beyond the MCID of 9 points for lower extremity injuries. A conservative postoperative protocol of 12 weeks NWB combined with physical therapy emphasizing ankle range of motion, balance and strengthening should be considered when providing care to individuals who sustain a severe, traumatic Lisfranc injury.


OPO298
MAGNITUDES OF MUSCLE ACTIVATION OF SHOULDER COMPLEX AND SPINE STABILIZERS DURING THE STANDARD PUSH-UP AND PUSHING EXERCISES USING A SUSPENSION STRAP TRAINING SYSTEM
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PURPOSE/HYPOTHESIS: Suspension training has become popular as it uses body weight resistance under unstable conditions eliciting a challenge to stabilizing muscles. The purpose of this study was to quantify muscle recruitment with surface electromyographic (EMG) sensors during 4 pushing exercises: (1) standard push-up (SPU); (2) Total Resistance Exercise (TREX); (3) TRX feet suspended (FSH); and (4) TRX hands suspended (HSU). Eight right-sided muscles were analyzed: serratus anterior (SA), anterior deltoid (AD), triceps brachii (T), upper erector spinae (UES), rectus abdominis (RA), external oblique (EO), internal oblique (IO), and pectoralis major (PM). We hypothesized exercise 3 (FSH) would elicit the greatest muscle recruitment (percent MVIC) in trunk and extremity muscles because of the dual instability of 4 limbs.

NUMBER OF SUBJECTS: Thirty-two healthy subjects volunteered to participate: 20 males (mean ± SD age, 24.6 ± 3.2 years) and 12 females (age, 23.6 ± 1.4 years).

MATERIALS/METHODS: We used a repeated measures within-subjects design for each muscle. Subjects performed each of the 4 exercises using a randomized testing sequence. Muscle recruitment levels (percent maximum voluntary isometric contraction [MVIC]) were obtained from each of 8 muscles. Two repetitions of each exercise were performed within a 10-second interval using a metronome to standardize movement speed. Data were sampled at a frequency of 1000 Hz. Raw EMG signals were bandpass filtered and subsequently processed with a root-mean-square algorithm using moving windows with 125-millisecond time constraints. EMG data collected during the 4 exercises were normalized to the muscles’ respective MVIC trials, and expressed as a percentage of the MVIC. Peak activation for each muscle was calculated from the normalized data using a 2-second window above the peaks of 2 consecutive concentric activation phases.

RESULTS: Data were examined with a repeated-measures analysis of variance (ANOVA) at α = .05. Post hoc comparisons of EMG recruitment across exercises for statistically significant ANOVAs were conducted with Bonferroni corrections for multiple comparisons. During SPU 3 muscles (SA, AD, PM) demonstrated high (41%-60% MVIC) EMG activation. During FSH 3 muscles (SA, AD, PM) generated high muscle recruitment (SA, AD, PM). During FSH 3 muscles (EO, AD, PM) produced high EMG activation. During HSU 3 muscles (EO, AD, PM) demonstrated high EMG activation.
CONCLUSIONS: Data illustrated the greatest muscle activation in 4 of 8 muscles (TB, RA, EO, IO) occurred during the HSPU exercise, one of single instability. The guy-wire concept may provide an explanation for the lower levels of recruitment in the core muscles observed in our study.

CLINICAL RELEVANCE: Exercises utilizing conditions of dual instability during pressing movements do not necessarily provide higher levels of muscle activation than conditions of single instability.

EFFECT OF 2 TYPES OF TAPE ON FOOT POSTURE AND RANGE OF MOTION BEFORE AND AFTER EXERCISE IN HEALTHY INDIVIDUALS

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PURPOSE/HYPOTHESIS: Prophylactic ankle taping is a common intervention used to reduce the risk of ankle sprains.10 Despite the evidence that the effectiveness of ankle taping in preventing unwanted joint movements decrease significantly after a 15-minute period, the use of prophylactic taping to prevent ankle injuries during sports continues to be an accepted practice.11 The loss of mechanical stability in traditional cloth athletic tape may be attributed to their high stretchability during physical activities.12 New tapes made of synthetic fibers stretch by less than 1% and are reported to have improved ability to protect ankles during athletic events.7 However, the effect of these new tapes on foot posture remains uninvestigated. Therefore, this study aimed to determine the ability of 2 different kinds of tape to alter foot posture and ankle range of motion (ROM) before and after exercise.

MATERIALS/ METHODS: Twenty-two healthy volunteers (17 female, 5 male) with a mean age of 22.2 ± 3.4 years were assigned to 3 groups. Group 1 (n = 7) was a control group with no tape applied. Cloth tape (1.5-inch “Coach Tape” by Zonas, Johnson and Johnson Consumer Products, Bridgewater, New Jersey) was used with group 2 (n = 8), and synthetic tape (1.5-inch “PowerTape” by Andover Health care Inc, Salisbury, Massachusetts) was used with group 3 (n = 7). A closed basket weave taping procedure was used for both groups 2 and 3. The participants’ ankle range of motion in 2 planes of motion: inversion/eversion and dorsiflexion/plantar flexion along with navicular height and foot width were measured before application of the tape, immediately after application of the tape, and after 30 minutes of physical exercise for each group. The 30-minute exercise routine consisted of running drills, stepping, and jogging on a treadmill.

RESULTS: All variables were normally distributed and a 2-way mixed ANOVA was used for the analyses. No statistical significance in the foot height or the foot width was found between groups or over time. For all 3 ROM measurements (eversion/dorsiflexion, and plantar flexion) there was no statistical significance (P>.05) between groups, but there was a significant difference (P<.05) for each kind of tape between pretape and posttape and between pretape and postexercise measurements.

CONCLUSIONS: Although the synthetic tape is reported to have less stretch than standard cloth tape, it appears that there is no significant difference in the ability to alter foot posture and ROM either before or after exercise. Additional research is warranted to confirm these findings and to determine the effectiveness of the synthetic tape with other taping procedures.

CLINICAL RELEVANCE: The study findings do not support the use of a synthetic tape over the standard cloth tape for altering foot posture and ankle range of motion (ROM) in clinical use.