Orthopaedic Section Abstracts: Poster Presentations
OPO1-OPO243

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**OPO1**

**EFFECTS OF DESENSITIZATION ON PAIN DISTRIBUTION AND NORMALIZATION OF SOMATOSENSATION IN A PATIENT WITH QUADRILATERAL COMPLEX REGIONAL PAIN SYNDROME**

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**BACKGROUND AND PURPOSE:** Complex regional pain syndrome (CRPS) is a chronic condition affecting 1 or more extremities that can develop after injury, involving constant limb pain, allodynia, and hyperpathic autonomical and somatic symptoms. Somatosensory desensitization (SD) has long been considered essential in CRPS treatment, yet efficacy evidence remains limited. This study's aim was to assess pain intensity and distribution differences between treated and untreated limbs, as well as potential somatosensory normalization of proximal nonpainful limb regions, following 10 weeks of SD in a patient with quadrilateral CRPS.

**CASE DESCRIPTION:** The patient was a 56-year-old male with incomplete C5 SCI. Eighteen months of physical therapy yielded nearly full functional unassisted mobility, yet constant searing pain and tactile allodynia developed in all extremities. Prior to seeking SD therapy, the patient experienced constant pain for 5 years following type II CRPS diagnosis. Quadrilateral involvement afforded an opportunity to desensitize 1 upper and 1 lower limb, allowing outcome assessment of treated and untreated limbs. During a 10-week treatment, the patient was exposed to progressively coarser materials via self-massage BID with weekly stimulus progression. Pain body diagrams (PBD) were completed pre and post SD and at 7-month follow-up. Changes in limb pain extent were quantified with pain distribution score (PDS) calculations applied to PBDs. Outcome measures taken weekly and at the 7-month follow-up on each limb included visual analog pain scale (VAS) and allodynia assessments via algometry. Semmes Weinstein monofilaments and 2-point discrimination testing revealed pretreatment subnormal somatosensory thresholds and acuity of proximal nonpainful limb areas, that subsequently normalized with corresponding reductions in distal pain. Other posttreatment changes included reduced allodynia and improvements in UE grip/pinch strength and axial loading tolerance in all limbs.

**DISCUSSION:** Prior literature suggests that SD can lead to decreased pain in treated limbs; however, changes in untreated painful areas have not been documented. After 10 weeks of SD, this spinal cord injured patient showed notable reductions in pain intensity, distribution, and allodynia in both treated and untreated limbs. Somatosensation in proximal, nonpainful areas normalized as pain decreased in more distal areas. These findings suggest central neuroplastic changes may occur from SD treatment, perhaps involving normalization of representation of affected and unaffected areas in the neuromatrix.


**OPO2**

**MANUAL THERAPY INTERVENTIONS FOR ADOLESCENT TO COLLEGIATE-AGED INDIVIDUALS WITH POSTCONCUSSION DISORDER: A RAPID REVIEW**

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**PURPOSE/HYPOTHESIS:** The purpose of this rapid review was to examine current literature related to manual therapy interventions for adolescent to collegiate-aged individuals with postconcussion disorder (PCD) with persistent headache, neck pain, or dizziness.

**NUMBER OF SUBJECTS:** Not applicable.

**MATERIALS/METHODS:** Eligible studies included randomized-controlled
A multimodal approach, including manual therapy interventions, is an effective way to decrease neck pain, headache and/or dizziness associated with PCD and the associated symptoms of neck pain, headache and dizziness. Evidence supports surgical intervention to halt further neurological decline in function. Given the wide range of signs and symptoms of myelopathy, diagnosis can be challenging and requires a thorough neurological screening. The ability of a physical therapist to adequately discern the presence of sinister pathologies masked as a musculoskeletal complaint has been a source of concern by some physicians in a direct patient access practice environment. The purpose of this case is to demonstrate a physical therapist’s ability to perform a complete review of systems with emphasis on neurological testing to make appropriate medical referral in a patient with undiagnosed cervical myelopathy.

CASE DESCRIPTION: A 48-year-old woman presented to a hospital-based outpatient orthopaedic physical therapy clinic after being referred by an orthopaedic surgeon for a complaint of chronic right knee pain. Prior to seeing PT, this patient was evaluated by a neurologist due to elevated creatine kinase level in the presence of imbalance and gait abnormalities. At that time, deficits were attributed to mechanical knee pain. Upon PT evaluation, she confirmed insidious onset of knee pain ongoing for 7 months and also endorsed stiffness, difficulty with gait and balance. Physical therapist’s evaluation produced findings inconsistent with mechanical knee pain. Furthermore, observational gait analysis prompted more in-depth neurological testing that revealed the presence of pathological reflexes, hyperreflexia and spasticity on multiple limbs with right side more pronounced. Per physical therapist’s recommendation, the patient was sent for a follow-up with referring provider as well as neurologist. Orthopedics ordered an MRI of her painful knee, which the radiologist deemed unrevealing. As recommended by the physical therapist, the patient returned for a second consult with a neurologist. An MRI of her cervical spine showed the presence of severe central canal stenosis at C4-5 confirming the suspected presence of cervical myelopathy.

OUTCOMES: Following the physical therapist’s recommendation, the patient received advanced imaging and a new physical exam by a neurologist. A diagnosis of cervical myelopathy was made and the patient was immediately scheduled for decompressive spinal surgery in order to prevent further neurologic compromise and maximize functional outcomes.

DISCUSSION: This case highlights the importance of continual consideration of nonmusculoskeletal problems as the cause of symptoms and the competence of a physical therapist in making appropriate medical referrals in light of the presence of red flags. By using a thorough review of systems and sound clinical reasoning, a physical therapist is able to request for additional testing to adequately diagnose the cause of signs and symptoms noted on examination.

**OPO3**

CROSS-CULTURAL ADAPTATION AND PSYCHOMETRIC PROPERTIES TESTING OF THE ARABIC ANTERIOR KNEE PAIN SCALE

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PURPOSE/HYPOTHESIS: The purpose of this study was to translate, develop a cross-cultural adaptation, and examine validity, test-retest reliability and feasibility of the Arabic version of the Anterior Knee Pain Scale (AKPS) in patients with Patellofemoral Pain Syndrome (PFPS).

NUMBER OF SUBJECTS: Forty subjects with age ranging from 18 to 50 years.

MATERIALS/METHODS: We followed international recommendations to perform a cross-cultural adaptation of the AKPS. The measurements tested were reliability, validity, and feasibility. The cross-cultural adaptation was conducted in 2 major stages: translation and cross-cultural adaptation and assessment of psychometric properties. The first stage was performed according to the guidelines published for the translation and cross-cultural adaptations of health-related questionnaires and adopted by the American Orthopaedic Surgeons Association (AOSA). The second stage employed the use of quality criteria for assessing properties of the questionnaire; this included (1) translation, (2) synthesis, (3) back-translation, (4) expert committee review, (5) pretesting, and (6) validation. The Arabic AKPS and the Arabic RAND 36-item Health Survey were administered to 40 patients who were diagnosed with PFPS. Participants were assessed at baseline for both scales and after 2 to 3 days, assessed with the Arabic AKPS only.

RESULTS: The Arabic AKPS showed high reliability for temporal stability, internal consistency (Cronbach’s alpha was .81 for the first assessment and 0.75 for the second), excellent test-retest reliability (intraclass correlation coefficients [ICC] = 0.96; 95% confidence interval [CI]: 0.93, 0.98) and good agreement (standard error of measurement [SEM], 1.8%). The Arabic AKPS was significantly correlated with physical components of the RAND 36-Item Health Survey (Spearman’s rho = 0.69; P<.001). No ceiling or floor effects were observed.

CONCLUSIONS: The Arabic AKPS is sufficiently reliable, valid, and appropriate for use as a patient reported outcome measure for Arabic-speaking individuals with patellofemoral pain syndrome.

CLINICAL RELEVANCE: The Arabic version of the AKPS can be used as a subjective and functional assessment tool for Arabic-speaking individuals with patellofemoral pain syndrome in daily clinical practice and in research studies.

OP06

NORMAL HOLD TIMES OF THE MODIFIED SIDE BRIDGE IN SUBJECTS 30 YEARS AND OLDER

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PURPOSE/HYPOTHESIS: The purpose of this study was to (1) determine average maximum endurance hold times for the modified side-bridge (on elbows and knees) position among healthy subjects 30 to 69 years old, (2) identify relationships between subjects’ characteristics (body mass index and sex) and the modified side-bridge hold times.

NUMBER OF SUBJECTS: Thirty subjects per age group participated (30-49 and 50-60 years).

MATERIALS/METHODS: A sample of convenience were recruited from universities and local businesses. Following completion of an informed consent and health status questionnaire, demographic information was obtained. Resting blood pressure, height, weight, body mass index (BMI) were assessed. Prior to testing, initial side-bridge hold side (left or right) was randomly determined. An instructional video was viewed to familiarize subjects with the testing procedure. Subjects performed the modified side-bridge on both sides with a 1-minute rest between efforts. One cue was given when the examiner noted deviation from the initial starting position. A second deviation within 15 seconds of the first, or hip contact with the mat terminated the testing procedure. Hold times were limited to a maximum of 3 minutes per side. Independent-samples t tests were used to identify differences in average hold times between age groups (30-49, 50-69), left and right hold sides, and sex. A Pearson correlation was used to identify relationships between BMI, exercise frequency, and hold times.

RESULTS: Subjects: n = 60 (23 male, 37 female; mean ± SD age, 47.2 ± 10.8 years) completed the study. The average hold times of the subjects were reported in seconds for sex and age groups: F (30-49 years old) = 100.45 ± 49.4 seconds (right) and 91.01 ± 50.1 seconds (left); M (30-49 years old), 129.63 ± 34.4 seconds (right) and 116.05 ± 38.7 seconds (left); F (50-69 years old) = 109.90 ± 56.7 seconds (right) and 106.49 ± 42.5 seconds (left); and M (50-69 years old), 127.06 ± 47.7 seconds (right) and 127.02 ± 50.2 seconds (left). Overall, males held the modified side-bridge longer than females with a mean difference of 23.4 seconds right side (P = .038) and 24 seconds left side (P = .027). No significant differences in hold times between age groups (30-49, 50-69) or test sides (right, left) were found. Fair, inverse correlations were found between BMI and hold times (right, r = -0.419; left, r = -0.359). Primary reasons for test termination were hip musculature fatigue in males and arm/shoulder muscular fatigue in females.

CONCLUSIONS: Modified side-bridge mean overall hold times in subjects 30 and older is over 1 minute. No significant difference in hold times between left or right sides or age groups were shown. There was a fair, inverse relationship between BMI classification and hold time. Males held significantly longer than females.

CLINICAL RELEVANCE: A modified side bridge is an adapted form for those whom may not be able to perform a full side bridge. Findings of the normal values for the modified side-bridge in healthy individuals 30 to 69 years may serve as useful tool when used clinically as a core endurance outcome measure.

OP07

AN INITIAL INVESTIGATION INTO A CLINICALLY FEASIBLE MEASURE OF MEDIAL LONGSITUDINAL ARCH FLEXIBILITY

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PURPOSE/HYPOTHESIS: Medial longitudinal arch (MLA) flexibility is clinically important due to its purported association with lower extremity in-
Multiple studies have utilized a variety of methods when measuring MLA height [1,5], and while most methods mutually employ the navicular as a bony landmark, small variances result in difficulty comparing between studies. To assess MLA flexibility independently of absolute height, researchers developed a measurement of the foot’s response to compressive loads, relative arch deformation (RAD) the RAD equation described by Nigg and collaborators [6] was later modified by Williams and McClay [7]. Methods reported in the literature are complex procedures, however, that may be unreasonable to perform with patients clinically. Such as using scales to load precisely 10% and 90% of body weight [6,7]. We propose a clinically simple method of obtaining 2 comparative measurements to determine RAD: the first seated, approximating an unloaded condition, and the second a bilateral stance, approximating 50% body weight loading. The purpose of this study was to compare results of this RAD methodology to published methods.

**NUMBER OF SUBJECTS:** Data were collected on the dominant stance foot, defined as contralateral to the preferred kicking limb, of each healthy adult participant (n = 45; mean age, 26.5 years; 8 male).

**MATERIALS/METHODS:** Weight, arch height seated (AHU), arch height standing (AH), and truncated foot length were measured and recorded. Arch height was measured at the dorsal aspect of the talonavicular joint. RAD, and AHU and AH normalized to truncated foot length, were calculated. Results were compared against reported mean values of Williams and McClay [7].

**RESULTS:** AHU and AH were significantly greater than the mean heights reported by Williams and McClay (AHU, P < .0001; AH, P < .0001), and there was no difference in truncated foot length (P = .42). Average RAD as calculated at 1.28 ± 0.67 N, significantly larger than the mean value reported by Williams and McClay of 1.05 ± 0.51 N (P = .02, Cohen’s d = 0.39).

**CONCLUSIONS:** Greater absolute arch heights measured in this study can be explained by our procedure of measuring at the dorsal aspect of the talonavicular joint versus previous definitions of 50% of foot length or highest aspect of the dorsum, which may result in more intersubject variability. Greater RAD may also reflect greater motion at this joint line, more indicative of real arch deformation during loading, or may be influenced by an 82% female sample [8]. Future studies will further explore validity, reliability, and functional significance of RAD measures.

**CLINICAL RELEVANCE:** We determined that a simple procedure of measuring arch height while seated, then standing with bilateral weight distribution, is a promising method of measuring RAD and quantifying MLA flexibility.

**OP8**

**RELIABILITY OF FABER MEASUREMENTS**

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**PURPOSE/HYPOTHESIS:** The FABER (Flexion Abduction External Rotation) test is an indicator of hip pain and range of motion (ROM) with emphasis on side-to-side asymmetry. Normative and reliability data regarding FABER are lacking. Additionally, while thigh length would influence FABER height, no study has examined use of an inclinometer versus standard ruler or considered normalizing to thigh length. Therefore, the purposes of this study were to determine normative values and inter and intrarater reliability of FABER height, thigh length normalized FABER, and interlimb FABER differences. We also compared intrarater reliability of FABER measured via a ruler, thigh length normalized, and via inclinometry.

**NUMBER OF SUBJECTS:** Nineteen participants without hip, knee, or lumbar spine pain (11 female, 8 male; mean ± SD age 23.5 ± 1.2 years).

**MATERIALS/METHODS:** Three testers performed measurements during 2 sessions (3-7 days between sessions). Passive FABER ROM was measured with the participant in the figure 4 position using a ruler (perpendicular distance from the lateral femoral epicondyle to table) and with an inclinometer. Next, thigh length was measured between the greater trochanter and the lateral epicondyle of the femur and was used to normalize FABER values obtained with the ruler (FABER/thigh length). The difference between limbs was calculated as the absolute value of right minus left FABER ruler measurements. Interrater and intrarater reliability were calculated in SPSS using interclass correlation coefficients (ICC). Minimal detectable change (MDC) was also calculated (standard error of the measure × 1.96 × √2).

**RESULTS:** Mean values for right/left FABER height were 12.3 ± 2.9 cm and 12.4 ± 2.7 cm. Mean thigh length normalized FABER for right/left were 0.29 ± 0.07 and 0.30 ± 0.07. Interrater reliability for height and normalized height were good (ICC = 0.62-0.73) and between session intrarater reliability were good to excellent (ICC = 0.70-0.88). FABER height and normalized FABER MDC for the 3 testers ranged from 1.2 to 1.9 cm and 0.02 to 0.05, respectively. Mean FABER difference was 2.0 ± 0.9 cm with poor intrarater reliability (ICC = 0.20), poor to good intrarater reliability (ICC = 0.38-0.66), and an MDC of 1.3 to 2.0 cm. FABER height measured with a ruler, normalized height, and inclinometry all resulted in excellent intrarater reliability, with the highest ICC for inclinometry (ICC = 0.84-0.87, 0.83-0.88, and 0.87-0.95).

**CONCLUSIONS:** Overall, FABER measurements were reliable, whether normalized to thigh length or not. Furthermore, results indicate that use of an inclinometer may increase reliability. However, we found poor to good reliability for assessment of interlimb differences in FABER.

**CLINICAL RELEVANCE:** This study established normative and MDC values for FABER and demonstrated that FABER measurements can be used reliably. However, due to poor to good reliability when assessing interlimb differences, more research is necessary to determine if FABER asymmetries can be reliably used to identify potential hip pathology, as has been suggested clinically.

**OP9**

**DIFFERENCES IN KNEE AND HIP ADDUCTION AND HIP MUSCLE ACTIVATION IN RUNNERS WITH AND WITHOUT ILIOTIBIAL BAND SYNDROME**

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**PURPOSE/HYPOTHESIS:** Increased hip and knee adduction has been reported in runners with iliotibial band syndrome. Recent reports have focused on the hip and neuromuscular factors to determine who may be at greater risk. The influence of muscle activation in the hip muscles has not been reported. We hypothesized that increased hip and knee adduction would be associated with increased tensor fasciae latae muscle activation, reduced gluteus medius and gluteus maximus muscle activation. The kinematic and activation differences were expected to be greater at 30 minutes than 3 minutes of running.

**NUMBER OF SUBJECTS:** Thirty.

**MATERIALS/METHODS:** Motion capture and surface electromyography were performed on 15 runners with iliotibial band syndrome and 15 matched controls. The average muscle activation was compared for the gluteus medius, gluteus maximus and tensor fasciae latae muscles. Kinematics were compared for peak hip adduction and knee adduction. Data were collected at 3 minutes and 30 minutes.

**RESULTS:** Injured runners demonstrated increased knee adduction compared to control runners at 30 minutes (P = .002; control, –1.46°; injured, 3.74°). The tensor fasciae latae (TFL) muscle activation in injured runners was increased compared to control runners at 3 minutes (P = .017).

**CONCLUSIONS:** The results of this study suggest that injured runners had increased knee adduction at 30 minutes and increased TFL muscle acti-
CONCLUSIONS: These findings were consistent with neuromuscular factors of the hip muscles and increased knee adduction in runners with iliobibial 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 iliobibial band syndrome. In addition, the increased deviation in knee adduction needs further investigation as a factor that affects kinematic changes during a prolonged run.

OP011
THE RELATIONSHIP BETWEEN THORACIC AND LUMBAR SPINE REPOSITIONING ERROR IN ASYMPTOMATIC YOUNG ADULTS
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PURPOSE/HYPOTHESIS: Recent literature has highlighted the potential for motor control deficits as underlying factors in the development of acute low back pain (LBP) or as factors that contribute to ongoing, chronic LBP. Spinal motor control may be represented through measurement of Repositioning Error (RPE). Altered lumbar RPE has been identified in patients with LBP and may indicate altered central nervous system processing and reduced proprioceptive awareness. These findings are well established for the lumbar spine, however the relationship between thoracic and lumbar spine RPE has not been reported. A recent systematic review revealed that lumbar RPE has not been assessed beyond 10 repetitions, leaving the effect of higher repetition tasks in asymptomatic individuals unknown. The purpose of this study is to determine the relationship between thoracic and lumbar RPE during a high repetition trunk flexion task in asymptomatic young adults.

NUMBER OF SUBJECTS: Twenty-eight asymptomatic individuals between the ages of 23 and 29 participated in this study (8 male, 20 female; mean ± SD age, 24.91 ± 2.044 years). Participants had no history of spinal injury or thoracic/lumbar pain requiring medical care in the last 2 years.

MATERIALS/METHODS: Anatomical markers were placed at the T4 and L2 spinous processes. Participants were placed in a seated position and asked to perform 50 repetitions of trunk flexion, at a self-selected speed, and were instructed to return to the starting position after each repetition. RPE was measured at T4 and L2 as the absolute distance from the starting position with the use of Dartfish video analysis software. Cumulative Repositioning Error (CREPE) was calculated in increments of 10 repetitions for both T4 and L2 spinal levels, in order to identify potential changes in relationship as the repetitions increased.

RESULTS: Thoracic and lumbar CRPE were strongly and significantly (P<0.05) correlated throughout all 50 repetitions and the strength of correlation was greatest in the largest repetition range. Repetition range and the associated Pearson’s r are supplied below: 1-10, 0.687; 1-20, 0.680; 1-30, 0.710; 1-40, 0.745; 1-50, 0.773.

CONCLUSIONS: As the repetitions increased past 20, so did the strength of correlation between thoracic and lumbar spine CRPE. The positive nature of the correlation also indicates that as absolute thoracic spine RPE increases, so does lumbar spine RPE.

CLINICAL RELEVANCE: The majority of research and intervention related to spinal RPE has focused on the lumbar spine. Given the greater ability for thoracic spine motion and the strong relationship between thoracic and lumbar spine RPE, especially as repetitions increase, perhaps more attention to motor control of the entire spine is needed. Motor control deficits at the thoracic spine may contribute to deficits at the lumbar spine. Future research is needed to determine whether motor control intervention at the thoracic spine can influence RPE of the lumbar spine, and whether or not these factors may contribute to the development and persistence of low back pain.

OP012
THE RECOGNITION AND TREATMENT OF AMPHIFIED PAIN SYNDROME FOLLOWING SALTER-HARRIS FRACTURE
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BACKGROUND AND PURPOSE: Chronic pain in children and adolescents can be treated effectively with a multidisciplinary approach including physical therapy. Amplified Pain Syndrome can occur following an orthopedic injury or trauma in adolescents and may contribute to adult chronic pain syndromes. Treatment of amplified pain syndrome using a multidisciplinary biopsychosocial treatment strategy is effective, however there
is a lack of practical, specific published treatment protocols available to guide physical therapists who may encounter this disorder in the outpatient setting. This case report serves to describe the treatment and associated outcomes in an 8-year-old child presenting with Salter Harris fracture who developed Amplified Pain Syndrome. Treatment strategies included functional neuromuscular re-education, desensitization techniques, graded exposure, and psychological interventions.

CASE DESCRIPTION: An 8-year-old girl was referred for treatment in an outpatient physical therapy setting for Salter Harris fracture of the right distal fibula following cast removal. She began physical therapy to address physical impairments related to immobilization. Potential amplified pain symptoms were noted at initial evaluation presenting as allodynia to light and rough touch as well as avoidance of all weight bearing on right lower extremity. Over the course of 1 month, she developed pain in the contralateral limb, bilateral wrists and hands, generalized hyperalgesia, abdominal pains, and headache and was diagnosed with Amplified Pain Syndrome. Treatment strategies expanded to include education to the patient and family regarding central nervous system sensitization, psychological interventions including mindfulness activities, and pain coping strategies. The treatment team was also expanded to include Cognitive Behavioral Therapy and Occupational Therapy based on successful treatment outcomes in pain rehabilitation programs. The patient was seen for 57 visits over 10 months. Outcome criteria included pain measures (FACES scale), functional self-report measures (Lower Extremity Functional Scale [LEFS]), gait and biomechanical task analysis.

OUTCOMES: The patient improved in all quantitative and qualitative outcomes. She met all functional age-appropriate milestones and gross motor skills without compensatory patterns including running, jumping, skipping, crawling, and stair climbing. The patient resumed all school activities with minimal modifications (compressive garments and seated on a pillow) and returned to participating in organized swimming and soccer. Clinically meaningful improvements were observed in pain and the LEFS.

DISCUSSION: The results of this case study describe the management of a child referred to physical therapy with an orthopaedic injury which developed into Amplified Pain Syndrome. The use of a holistic biopsychosocial management approach and a multidisciplinary team was associated with clinically meaningful improvements in pain and function and resumption of her usual school and recreational activity participation.

Combined Sections Meeting

A 24-year-old female student presented to PT 8 days after a fall while ice climbing. The patient landed on her left foot, which became fixed in dorsiflexion due to the nature of her ice climbing boots and crampons. Immediately after the fall, she was unable to weight bear and presented to urgent care the next day. Standard AP, lateral, and mortise radiographs were taken and the PA read them as normal. The PT evaluation found moderate ankle pain, tenderness along both malleoli, anterior talofibular ligament and insertion of the Achilles. Significant edema and bruising were observed on the medial and lateral aspects of her ankle and anterior tibia. Passive and active motion was limited in all directions. Special tests revealed marked laxity in the anterior and posterior talofibular and calcaneal fibular ligaments.

OUTCOMES: Due to the high-energy mechanism of injury (MOI), lack of improvement in weight bearing, significant pain, and positive ligamentous testing, PT was ceased. She was referred to the student health center for more imaging due to the high level of suspicion of an undiagnosed fracture or complex ligamentous injury. The patient had an MRI which revealed a left displaced LFT fracture. Subsequently, the patient was referred to an orthopaedic surgeon for definitive ORIF of the LFT. The surgeon reported no complications. But, he did report finding a small detachment of articular cartilage from the posterior calcaneus. This should have no long-standing effect on the patient’s prognosis.

DISCUSSION: It is essential for PTs to know the MOI and presentation of LFT fractures as many are missed at initial evaluation and with plain radiographs. PTs should suspect an LFT fracture in patients with injuries resulting from high impact loading in dorsiflexion. Upon exam, patients may have significant pain, inability to weight bear, tenderness distal and anterior to the lateral malleolus, and severe edema and ecchymosis.

OPO15

PERFORMANCE AND RELIABILITY OF THE CERVICAL JOINT POSITION ERROR TEST IN HIGH SCHOOL ATHLETES

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PURPOSE/HYPOTHESIS: The cervical joint position error test (CJPET) provides an objective measure of neck reposition sense and has been shown to document differences between healthy controls and individuals suffering from whiplash associated disorders and chronic neck pain. The majority of these studies assessed middle aged individuals and some have assessed younger adults (18-19 years old). With the number of adolescents participating in high school sports on the rise along with the number of sports injuries involving the head and neck, having performance data and information on the reliability of this test in this population is needed. The primary purpose of this study is to (1) describe the performance of the Cervical Joint Position Test Error (CJPET) in a cross-sectional population of adolescents, (2) examine the associations between sex, age, and body mass on the performance of the CJPET, and (3) describe the test-retest reliability of the CJPET in a subsample of adolescents.

NUMBER OF SUBJECTS: One hundred eighteen high school athletes (91 male, 27 female) with an average ± SD age of 15.07 ± 1.15 years.

MATERIALS/METHODS: Subjects performed the cervical joint position error test that included 6 measurements in each direction (flexion, extension, right rotation, and left rotation). The head mounted laser method was used and order of direction of testing was randomized. Seventeen of these participants performed the test at 2 different times to assess the reliability of the cervical joint position error test. The distance in error was recorded in cm and converted to degrees of error.

RESULTS: Average error for all directions combined was 3.59° ± 1.31°. Extension had the highest frequency of error at 33% of the participants. Ninety-five of the 118 (80.51%) participants were classified as “abnormal” using the accepted norm as 4.5° as the cutoff point. There was an inverse correlation (r = -0.218, P = .018) with relation of BMI and total number of joint positions classified as abnormal. There were no significant correlation between sexes (P = .75) and with age (r = -0.134, P = .152) ICCs ranged from 0.70 to 0.87, indicating moderate to good reliability in all directions. The majority of MDC was between 2.2° to 4.7°, with extension being the highest.

CONCLUSIONS: There appears there are larger errors in the healthy adolescent population as compared to healthy adults resulting in the possibility of needing a larger error accepted cut-off point for this younger population compared to the 4.5° currently used in adults. BMI has an impact on the performance of the CJPET. Those with higher BMI had a reduced amount of errors). The CJPET appears to be a reliable assessment tool in this population.

Clinical Relevance: This study was the first to the author’s knowledge to analyze the performance characteristics of adolescent population on the CJPET. Having performance measures of the CJPET in this population could be a reference for clinicians treating an adolescent patient with neck pain or whiplash as these injuries are occurring at an increased rate in the high school population.

OPO16

SCREENING FOR LATERAL PROCESS OF TALUS FRACTURE IN PHYSICAL THERAPY

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BACKGROUND AND PURPOSE: Fracture of the lateral process of the talus (LPT) is a rare injury, making up 0.86% of 1500 cases of ankle sprains or fractures. This fracture often presents with signs and symptoms similar to a severe ankle sprain, which leads to misdiagnosis and definitive treatment [1-3]. According to a study of 39 cases of LPT fracture, only 59% were correctly diagnosed initially. This study shows that these fractures are difficult to see on plain radiographs, increasing the probability of being missed upon initial examination [4]. Long term consequences of misdiagnosed LPT fractures include lateral hindfoot impingement [5], loose bodies in the subtalar joint [6], malunion, nonunion, posttraumatic arthritis, or avascular necrosis [7,8].

CASE DESCRIPTION: A 24-year-old female student presented to PT 8 days after a fall while ice climbing. The patient landed on her left foot, which became fixed in dorsiflexion due to the nature of her ice climbing boots and crampons. Immediately after the fall, she was unable to weight bear and presented to urgent care the next day. Standard AP, lateral, and mortise radiographs were taken and the PA read them as normal. The PT evaluation found moderate ankle pain, tenderness along both malleoli, anterior talofibular ligament and insertion of the Achilles. Significant edema and bruising were observed on the medial and lateral aspects of her ankle and anterior tibia. Passive and active motion was limited in all directions. Special tests revealed marked laxity in the anterior and posterior talofibular and calcaneal fibular ligaments.
Clinicians should also rule out LPT fracture in patients with nonhealing ankle sprains due to the potential for misdiagnosis. Using the patient’s history of the MOI and clinical findings, PTs can screen for this commonly missed fracture to minimize long term repercussions and secure definitive treatment in a timely fashion.


OP017
CHANGES IN LUMBAR MULTIFIDUS MUSCLE THICKNESS DURING COMMON SPINE STABILIZATION EXERCISES
USING REHABILITATIVE ULTRASOUND IMAGING
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Purpose/Hypothesis: Lumbar paraspinous musculature, particularly the lumbar multifidus muscle (LMM), plays a key role in spinal stability during dynamic activities. Selective exercises targeting the core muscles has been shown to be effective for improving spinal stability; however, efficacy of these exercises has yet to be determined. Rehabilitative ultrasound imaging (RUSI) has been utilized to assess changes in muscle thickness reflective of muscle activation. The purpose of this study was to determine which commonly prescribed core exercises demonstrated the greatest change in LMM thickness using RUSI.

Number of Subjects: Twenty healthy subjects (10 female, 10 male; mean age, 23.75 years; height, 67.25 inches; weight, 154.6 lb; body mass index, 23.46 kg/m²).

Materials/Methods: Prior to data collection, intra and intertester reliability of the 6 testers using RUSI was determined by measuring LMM thickness on 6 different subjects. Data collection included using RUSI to measure thickness changes of the right LMM at the level of the fourth lumbar vertebrae while 4 commonly prescribed trunk stabilization exercises were performed. The exercises included: prone Superman, bird dog, seated row, and Paloff Press. Thickness changes were determined by subtracting the LMM thickness at rest from the thickness at peak contraction, and the change for 3 trials of each exercise was averaged for analysis. Cronbach’s alpha and Intraclass correlation coefficients (ICC) were used to determine intratester and intertester reliability of RUSI measurements of the LMM. A 1-way analysis of variance (ANOVA) was used to determine significant changes in muscle thickness for each exercise.

Results: Four out of the 5 testers demonstrated strong intratester reliability with values that ranged from 0.81 to 0.99, with 1 tester falling outside that range (0.27). Intertester reliability was moderately strong with a value of 0.753. All 4 exercises showed increases in LMM thickness, but significant increases were seen in the Superman (P<.01) and bird dog exercises (P<.01).

Conclusions: Increases in LMM thickness varied across 4 commonly prescribed core stabilization exercises among healthy young adults. The results suggest that prone and quadruped positions may isolate LMM more effectively than exercises in seated and standing positions.

Clinical Relevance: Knowledge about muscle activation in lumbar stabilizers during certain exercises may be helpful when prescribing exercises for patients with low back pain related to trunk instability.

OP018
PSYCHOLOGICALLY INFORMED PHYSICAL THERAPY: DESCRIBING TREATMENT MONITORING FOR HIGH-RISK LOW BACK PAIN
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Purpose/Hypothesis: Psychologically informed physical therapy (PIPT) for low back pain (LBP) involves targeting psychological factors in conjunction with impairment based physical therapy. Treatment monitoring is an important part of PIPT and involves identifying changes in key process measures to better inform clinical decision making. Therefore, the purpose of this case series was to describe treatment monitoring during a 4-week period for patients with LBP and high risk for prolonged disability.

Number of Subjects: Patients (n = 23) identified as high risk using the STarT Back Tool and enrolled in a preliminary pragmatic implementation study.

Materials/Methods: Physical therapists (n = 5) were educated on using psychological measures (Fear-Avoidance Beliefs Questionnaire [FABQ-PA, FABQ-W], Tampa Scale of Kinesiophobia [TSK-11], Pain Catastrophizing Scale [PCS] and Fear of Daily Activities Questionnaire [FDADQ]) for treatment monitoring. Outcome measures (numeric pain rating scale [NPRS], Oswestry Disability Index [ODI] and lumbar flexion range-of-motion [ROM]) were administered at intake and 4 weeks later. Spearman’s rho correlation coefficients were calculated to identify univariate relationships among psychological and clinical measure change scores. One-way analysis of covariance (controlling for baseline outcome measure) was used to identify how change in psychological measure and 4-week clinical outcomes were associated.

Results: Moderate to strong positive associations among all psychological measure change scores were observed (r = 0.51-0.79, P<.01). Changes in FABQ-PA, PCS and TSK-11 scores were correlated with changes in ODI scores (r = 0.48-0.78, P<.05) while only FABQ-PA change scores were correlated with changes in lumbar flexion ROM (r = -0.68, P<.01). Associations between psychological measure and NPRS change scores were weak (r = 0.01-0.25, P>.05). After controlling for intake ODI scores, change in FABQ-PA (r = .01; partial n² = 0.42) and PCS (r = .05, partial n² = 0.26) scores contributed to 4-week ODI scores. Similar associations were not identified for 4-week NPRS or lumbar flexion ROM (P>.05).

Conclusions: Several psychological measures have the potential to aid clinical decision making for self-reported disability, while only FABQ-PA was correlated to physical impairment. Treatment monitoring for pain intensity was not supported in this sample.

Clinical Relevance: Treatment monitoring during PIPT has potential to enhance clinical decision making by identifying certain aspects of treatment that may require additional attention to obtain optimal clinical outcomes for patients at higher risk for poor LBP outcomes. Using psychological measures seems to have stronger implications for disability outcomes, with further research required for identifying measures that exhibit stronger covariation with pain intensity outcomes.

OP019
DISCRIMINATIVE AND RELIABILITY ASSESSMENT OF PARASPINAL MUSCLE CROSS-SECTIONAL AREA MEASUREMENTS FROM MAGNETIC RESONANCE IMAGES OF PERSONS WITH LOW BACK PAIN IN NOVICE EXAMINERS: A NEW CLINICAL MEASURE
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Purpose/Hypothesis: Lumbar paraspinal muscle (PM) atrophy is common in persons with low back pain (LBP). Clinical methods to quantify PM
size are limited. Patients with chronic low back pain and patients awaiting microdiscectomy frequently receive magnetic resonance (MR) images which can be examined by the treating clinician. The purpose of this study was to determine the reliability and discriminative validity of PM (rectus spinae (ES), psoas (PS) and quadratus lumborum (QL)) cross-sectional area (CSA) measurements performed by novice examiners. 

**NUMBER OF SUBJECTS:** MR images from 3 groups: (1) chronic LBP, mild disability, n = 14; (2) matched group without LBP, n = 14; (3) 14 unmatched patients awaiting microdiscectomy.

**MATERIALS/METHODS:** Two groups of 4 examiners (2 physical therapy students and 2 orthopaedic physical therapists), performed the measurements. Each received 1 hour of instruction and a manual to perform measurements using ImageJ software (Free NIH download) prior to performing the measurements. Each examiner, blinded to group, performed PM and L5 vertebral body (VB) CSA measurements from each image series. CSA values were normalized to vertebral body (VB) CSA to generate a PM/VB ratio to normalize for body size differences. Intraclass correlation coefficients (ICCs) were calculated to estimate reliability. Area under the curve (AUC) of the receiver operator characteristic curve was calculated to determine if the measurements could discriminate between persons with and without LBP.

**RESULTS:** IntereXaminer reliability consisted of 18 comparisons across the 3 patient groups. For ES, agreement was moderate to substantial in all comparisons (ICC range, 0.70-0.95) of muscle CSA. Agreement was substantial in 17 of 18 comparisons (ICC range, 0.79-0.97) of ES/VB ratio. For PS, agreement was moderate to substantial in 17 of 18 comparisons (ICC range, 0.70-0.95) of muscle CSA. Agreement was moderate to substantial in 18 of 18 comparisons (ICC range, 0.53-0.99) of PS/VB ratio. For QL, agreement was moderate to substantial in 18 of 18 comparisons (ICC range, 0.76-0.97) of muscle CSA. Agreement was moderate to substantial in 18 of 18 comparisons (ICC range, 0.51-0.96) of QL/VB ratio. Three of 4 examiners showed significant discriminative validity between healthy and premicrodiscectomy groups with either QL CSA or QL/VB ratio. Agreement was moderate to substantial in 17 of 18 comparisons (ICC range, 0.79-0.97) of muscle CSA. Agreement was moderate to substantial in 16 of 18 comparisons (ICC range, 0.51-0.96) of QL/VB ratio.

**CONCLUSIONS:**: This preliminary data suggests that SMT reduces gluteal muscle activation immediately following the manipulation. Further work in this area is warranted.

**CLINICAL RELEVANCE:** These findings do not support the hypothesis that SMT may be effective due to its effect on gluteal muscle activation.

**OPO20**

**THE EFFECTS OF LUMBAR ROTATIONAL MANIPULATION ON GLUTUEAL MUSCLE ACTIVATION DURING FUNCTIONAL ACTIVITIES IN PERSONS WITH CHRONIC LOW BACK PAIN**

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**PURPOSE/HYPOTHESIS:** Evidence supports the effectiveness of spinal manipulative therapy (SMT) for persons with chronic low back pain. However, little is known regarding the underlying mechanisms for its effectiveness. Improved muscle activation following mobilization or manipulation has been reported in the multifidus, abdominal muscles and quadriceps. Recent evidence supports the premise that impaired gluteal muscle performance may play an important role in low back pain. However, the effects of lumbar manipulation on gluteal muscle activation is lacking. The purpose of this experiment was to generate pilot data for a future study which would analyze the immediate effects of lumbar spinal manipulation on gluteal muscle activation during functional activities. It was hypothesized that gluteal muscle activity would increase postSMT in subjects with CLBP during the performance of functional tasks.

**NUMBER OF SUBJECTS:** Three (2 men, 1 woman; ages 18, 40, and 18 years) with chronic non radicular LBP were recruited. Subjects were excluded if they had spinal surgery, osteoporosis or a positive straight-leg-rise. Pain duration was 10, 4, and 0.5 years and Oswestry Disability score were 20%, 26%, and 26% disability.

**MATERIALS/METHODS:** Prior to instrumentation, subjects practiced the 2 functional tasks: (1) step-up, (2) forward bending. The pace of each task was set using a metronome for 5 repetitions. The tasks were performed prior to and immediately following side-lying rotational lumbar thrust manipulation. To record gluteal activity and avoid crosstalk, intramuscular electrodes were inserted into gluteus medius and maximus on the side of greatest low back pain. EMG signals were sampled at 2000 Hz and high-pass filtered at 10 Hz. The signal was smoothed with a root-mean-square using a 75-millisecond moving window. Onset and offset of the EMG signal for each repetition was visually determined with high reliability (ICC<sub>1,1</sub> = 0.99 for each muscle). The average amplitude for the 5 repetitions was calculated for each task before and after the manipulation. Percent change [(mean RMS (post Rx) – mean RMS (pre Rx))/mean RMS (pre Rx)] was the dependent variable. Effect sizes were calculated.

**RESULTS:** During the step-up, the change in EMG amplitude for gluteus medius in each subject was ~50.7%, ~7.7%, and ~21%, and for the gluteus maximus ~29.8%, ~74.1%, and 1.6%, respectively. During forward bending, the change in EMG amplitude for gluteus maximus in each subject was 13.9%, 30.0%, and 5.7%, respectively. Effect size for gluteus medius during step-up: −0.96; gluteus maximus: −0.90; forward bending, gluteus maximus: −0.71.

**CONCLUSIONS:** This preliminary data suggests that SMT reduces gluteal muscle activation immediately following the manipulation. Further work in this area is warranted.

**CLINICAL RELEVANCE:** These findings do not support the hypothesis that SMT may be effective due to its effect on gluteal muscle activation.
C O M B I N E D  S E C T I O N S  M E E T I N G

Administered Leeds Assessment of Neuropathic Symptoms and Signs (S-LANSS).

OUTCOMES: Marked improvements were observed for total cervical AROM, P4 Instrument, NDI, IES-R, PCS, and S-LANSS at time of discharge. Group and individual patient data is presented with use of radar plots surveying pain from a biopsychosocial model.

DISCUSSION: This case series provides preliminary data to support further formal investigation utilizing a biopsychosocial model for the assessment of pain in not only WAD, but other musculoskeletal disorders. The results provide a visual depiction of the heterogeneous WAD condition, providing the clinician with a detailed assessment of pain and disability to assist in determining prognosis, implementing a plan of care, and monitoring recovery. Further research will survey other domains of pain processing; physiological, psychological, and social factors not assessed in this preliminary proof-of-concept study. Application of this assessment method in a busy clinical environment is dependent upon the ability to capture all known prognostic domains of a multifaceted condition. Such practice may allow the clinician to deliver individualized care that reduces pain and improves functional outcome on a patient-by-patient basis.


OP022

THE EFFECT OF DRY NEEDLING ON PAIN REDUCTION IN SUBJECTS WITH MYOFASCIAL TRIGGER POINTS IN THE UPPER TRAPEZIUS: A SYSTEMATIC REVIEW

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PURPOSE/HYPOTHESIS: Due to sedentary lifestyles in today’s society, myofascial pain of the neck and shoulder region are commonly seen by physical therapists. This pain can be due to prolonged muscle activity which creates muscle imbalance resulting in trigger point formation. Interventions for myofascial trigger points have been developing in recent years. Today, dry needling has become much more common to the point of potentially becoming part of foundational sciences in physical therapy. Since dry needling has become more common, physical therapists need to know: how effective dry needling is on pain reduction in patients with myofascial trigger points in the upper trapezius?

NUMBER OF SUBJECTS: Two hundred thirty-six.

MATERIALS/METHODS: Databases searched for relevant studies were CINAHL complete, MEDLINE, MEDLINE with Full Text, SPORTDiscus, Science Reference Center, Cochrane Central Register of Controlled Trials, and OVID. The searches used the key words “dry needling” and “upper trapezius.” The initial search resulted in 103 studies with a reduction to 53 studies after duplicates were removed. All 53 studies were screened by title and abstract resulting in 41 records being excluded due to additional treatments used in conjunction with dry needling or nonrelevant studies associated with the topic. Full text analysis of the 12 remaining studies led to 6 more studies excluded. The 6 included studies were assessed for level of research and strength of quality using an assessment tool by the American Academy for Cerebral Palsy and Developmental Medicine.

RESULTS: Of the 6 studies analyzed, 4 were categorized as Level II randomized controlled trials (RCT) while the remaining 2 were Level IV case series. Two RCTs scored strong quality of 7/7 while the other 2 scored a moderate quality 4/7. The 2 case series scored a strong 6/7 and moderate 5/7. The quality of research was moderate to strong overall. The study results reveal dry needling decreases pain via Visual Analog Scale and Numeric Pain Rating Scale. Additionally, dry needling decreases subject perceived level of disability via Pressure Pain Threshold and Disabilities of the Arm, Shoulder, and Hand. The study results also reveal overall improvement in mood and quality of life via Short Form Health Survey-36.

CONCLUSIONS: It is clearly evident dry needling is beneficial at reducing pain in the upper trapezius muscle. Each study used some type of patient reported pain rating scale. The results of each study showed that pain ratings decreased, proving effectiveness of dry needling treatment for reducing myofascial pain.

CLINICAL RELEVANCE: Dry needling is an effective intervention for upper trapezius myofascial pain but has additional benefits as well. The intervention is less costly than other physical therapy treatments and is much less time consuming, taking only seconds to administer. Dry needling also has the potential to reduce the number of visits for a pain reduction benefit compared to other current interventions.

OP023

THE EFFECT OF DRY CUPPING AND EXERCISE ON LOW BACK PAIN AND RANGE OF MOTION: A CASE STUDY

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BACKGROUND AND PURPOSE: Dry cupping (DC) is a noninvasive modality that is gaining popularity in the areas of massage and physical rehabilitation despite the scarce amount of research available. The most common
indication for DC is musculoskeletal pain. Past studies have found that DC can decrease musculoskeletal pain in the neck and low back. Fewer studies have shown DC can decrease pain and increase range of motion (ROM). The purpose of the present case report is to determine the effects of DC and simultaneous exercise on low back pain and range of motion.

**CASE DESCRIPTION:** The subject was a 24-year-old female that had been experiencing chronic recurring low back pain for greater than 2 months. The subject had limitations in multisegmental flexion or extension and experienced increases in pain with active ROM of the lumbar spine.

**OUTCOMES:** For this case 4 cups were applied to the subject’s low back while prone and remained in place for 10 minutes. The cups were then removed and 4 cups were applied to the anterior thigh on each leg. Next, the subject performed knee flexion and extension in the seated position on each leg for 2 sets of 10. The cups were removed and another 4 cups were applied to the posterior thigh. The subject then performed 2 sets of 10 active straight leg raises (SLRs). The subject repeated the intervention every 2 days for a total of 3 treatments. A fourth follow-up session was scheduled a week later to reassess outcome measures. The following measures were assessed prior to the first treatment session and in the fourth follow-up session: Selective Functional Movement Assessment (SFMA), categorization for multisegmental flexion and extension, SLR PROM, Pain Pressure Threshold (PPT) for areas of the low back and lower extremity, and the Oswestry Disability Index (ODI). The numeric pain rating scale (NPRS) was also taken pre and post intervention for each session as well as the global rating of change (GROC) for the low back. In addition, the subject’s worse NPRS rating for the low back over the past 7 days was taken. Notable changes include a 15° increase in left SLR PROM, a decrease in ODI score from 20% to 12%, a GROC increase of 3, notable increases in all PPT locations, and decreased NPRS scores. The subject’s NPRS scores decreased after each treatment session and the NPRS at worst over the past 7 days also decreased from a 5/10 to a 2/10. The subject also reported 0/10 NPRS scores after treatment session 2 and 3 as well as in the fourth follow-up session. There were no changes in SFMA categories for multisegmental flexion or extension.

**DISCUSSION:** In this case report, we examined the effects of DC in addition to exercise on low back pain and ROM. Overall, there were improvements in any one of the outcome measures including pain, ROM, and PPT. To our knowledge, there are no studies examining the effects of DC with simultaneous exercise for low back pain. Future studies are needed to test the protocol against a control on a large sample size.

**REFERENCES:**
uromic acid injections. Although these previous treatments provided minimal benefit, the patient sought further management by another physical therapist. Physical examination findings at the time of the most recent physical therapist evaluation revealed an antalgic gait characterized by decreased stance phase on the left. Although knee range of motion was within normal limits, decreased patellofemoral joint mobility and patellofemoral joint crepitus and tenderness to palpation along the lateral aspect of the patella were noted. Quadriceps and hamstring muscle weakness was also noted. Ligamentous and meniscal testing was normal. Magnetic resonance imaging findings revealed moderate to severe chondromalacia at the lateral patellar facet.

OUTCOMES: In addition to management by a physical therapist, the patient received a series of 3 prolotherapy injections to the knee, each 3 to 4 weeks apart. Physical therapy management consisted of manual therapy for lower quarter soft tissue and joint mobilization, targeted therapeutic exercise to address strength deficits of the quadriceps and hamstring muscles, and a gradual return to weight-bearing exercise and functional activity. At 4 months following the physical therapy and prolotherapy injections, the patient reported no pain during daily activities. Additionally, he had a normal gait, no complaints of stiffness, and full strength of the quadriceps and hamstring muscles. Additionally, he had returned to swimming, cycling, unlimited walking and hiking on various surfaces, and agility drills.

DISCUSSION: In patients with knee pain and chondromalacia patella, especially those who have not responded to prior interventions, physical therapy combined with prolotherapy may serve as a treatment option.


OP026

IMPACT OF TOURING, PERFORMANCE SCHEDULE, AND DEFINITIONS ON 1-YEAR INJURY RATES IN PROFESSIONAL MODERN DANCERS

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PURPOSE/HYPOTHESIS: This study augments recent analysis of injury rates over 15 years in a professional modern dance company. Time-loss injuries (TLinj) averaged 0.16 injuries/1000-h exposure. Medical attention injuries without time loss or injury report, defined as complaints, were not analyzed. Our objective was to examine the relationship between touring, performance, rehearsal schedule and injury in this company over 1 year in greater detail. This granularity may permit insight into the physical demands upon professional dancers.

NUMBER OF SUBJECTS: Thirty-five dancers; 17 male (mean ± SD age, 29 ± 6 years).

MATERIALS/METHODS: Prospective data for this company were recorded over 1 year, tracking new work-related musculoskeletal injuries (WMSE) involving an injury report, TLinj, complaints, diagnoses, and exposure hours. Injury data were excluded if sustained outside working hours, or defined as a re-injury occurring within 8 weeks of original diagnosis.

The year was divided up into 6 segments alternating with breaks approximately 6 days. Injuries occurring during each segment were converted to injuries/1000-h dance exposure to allow comparisons of the effects of performance, rehearsal and travel. We conducted a quasi-Poisson analysis to determine differences between segments, sex, dance experience, covaried with combined travel-performance days (P<.05).

RESULTS: Twenty WMSI and 10 TLinj were sustained by dancers over 1 year: 0.44 WMSI and 0.22 TLinj/1000-h exposure. There were significantly small WMSI differences between segments but no differences due to sex or experience. WMSI were 6 times more likely to occur in Segment 6 (IRR = 6.033, P = .031), with 1.0 injuries/1000-h exposure. The highest rate of TLinj and traumatic injuries also occurred in segment 6 (0.57/1000 h). The greatest number of overuse injuries, 0.57/1000-h, were in segment 2, during an international tour. Although covariance with travel days was not significant, there was a moderate correlation between WMSI and travel days (r = 0.53). There was a ratio of 55%:45% trauma:overuse WMSI and 80%:20% TLinj over the year. Complaints/1000-h were fairly evenly distributed across segments as physical therapy hours were also consistent. The majority of WMSI and TLinj were muscle-tendon diagnoses, affecting the lower leg, Achilles and cervical areas.

CONCLUSIONS: High rates of WMSI, TLinj and traumatic injuries in segment 6 reflected a concentrated period of learning new choreography, 2 weeks NY season and 1 week travel/performance abroad without break. We attribute the large number of overuse injuries in segment 2 to raked stages encountered on tour. While tracking complaints permits understanding of stressors to specific body regions and utilization of resources, WMSI and TLinj are the most important to track for injury surveillance. CRITICAL RELEVANCE: Time zones can affect sports performance however we have no method to quantify performance in dance other than injury. This may mask the effects of frequent travel on dancer’s well-being. Future studies will focus on the effect of travel on longer international tours.

OP027

THE NATURE OF MOVEMENT SYMMETRY: IMPLICATIONS FOR FUNCTION AND INJURY RISK

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PURPOSE: The purpose of this report is to identify movement asymmetries that negatively impact function or increase the risk for injury, and therefore warrant physical therapy intervention.

DESCRIPTION: Movement asymmetries can present in a variety of ways, including range of motion, force production, morphology and neuromuscular control. Asymmetries might affect functional performance or injury risk. Quality of life might be negatively impacted for several reasons, such as loss of playing time in sports, inability to work, and decreased social participation. Currently there is limited evidence to identify which asymmetries negatively impact function and injury risk, and at what point physical therapy intervention would be beneficial. To aid in identifying such asymmetries, a review of the literature was completed. Sixty-nine peer-reviewed studies met the inclusion criteria and were analyzed for the effect of force production, mobility, and neuromuscular control asymmetries on functional performance and injury risk. Excluded were studies of neurological conditions, structural spinal conditions or leg length discrepancies, and studies that included prepubescent children.

SUMMARY OF USE: There is strong evidence that supports the importance of symmetrical force production for optimal function and low injury risk. However, there is inconsistent evidence on the degree of asymmetrical force that creates functional limitations or increased injury risk. Asymmetrical mobility is general defined as a side-to-side difference greater than 10%. However, some activities are inherently asymmetrical, and having those asymmetries is advantageous to function (eg, overhead throwing). The evidence suggests that sports such as soccer or basketball might demand more symmetry of the limbs, therefore side-to-side
mobility differences are more likely to increase injury risk. The available research demonstrates that asymmetries in balance and neuromuscular control are present in a variety of populations. The preponderance of evidence suggests that a lack of neuromuscular control and side-to-side asymmetry places the individual at an increased risk of injury, though targeted training has often proven to decrease such deficits, with subsequent decreases in the risk of injury. Trauma and several chronic conditions (eg, chronic ankle instability, anterior cruciate ligament rupture) are associated with movement asymmetries and degeneration of affected joints.

**IMPORTANCE TO MEMBERS:** A general trend in the literature revealed that LE asymmetries have a more pronounced negative impact on function and injury risk than UE asymmetries. Movement symmetry appears to be most important: (1) following injury to indicate readiness for return to sport, and (2) for tasks associated with bilateral weight bearing, since altered movement in 1 limb might transfer excessive stress to the other. Movement symmetry appears relatively less important when: (1) functional tasks demand asymmetrical patterns (eg, throwing, kicking sports), and (2) loads involved remain within the tissue tolerance.

**OP028**

**AN INVESTIGATION OF FUNCTIONAL MOVEMENT IMPAIRMENTS IN YOGA PRACTITIONERS BEFORE AND AFTER YOGA POSTURE TRAINING AND WITH TARGETED EXERCISE INTERVENTION**

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**PURPOSE/HYPOTHESIS:** Movement impairments involve faulty movement patterns including abnormalities in posture and musculature. Spine and/or extremity deficits cluster to form movement impairments, which may result in mechanical breakdown over time. The study purpose was 3-fold: (1) investigate the extent to which common movement impairments were found in a group of asymptomatic yoga practitioners prior to participation in an 8-week yoga training course, (2) assess the extent to which movement impairments initially identified changed upon completion of an 8-week yoga training course, and (3) assess response to a follow-up 6-week home exercise program (HEP) that addressed individual impairments of participants. Our study focused on the following movement impairments as described by Sahrmann: cervical extension rotation, scapular depression and downward rotation, anterior glide and medial rotation of the shoulder, lumbar extension rotation, anterior glide and medial rotation of the hip and dominant hamstrings.

**NUMBER OF SUBJECTS:** Twelve.

**MATERIALS/METHODS:** Twelve subjects (3 male, 9 female; mean ± SD age, 28 ± 8.06 years). Inclusion criteria: greater than 18 years of age, greater than 3 months of participation in yoga, registration and completion of an 8-week yoga training course, functional AROM and PROM in all extremities, greater than 3 months without major injury, and no current spine abnormalities. Prior to initiation of an 8-week yoga training course, each participant was assessed using functional movements, and postural and muscular length/strength measurements. Identified deficits were placed into appropriate categories, ranked from 0 to 3 (0, absent; 3, severe). Assessment of movement impairments, defined and measured by Sahrmann, were performed for each participant prior to initiation and at completion of the training course.

**RESULTS:** Movement impairments existed in all subjects prior to participation in an 8-week yoga training course. At completion of the training course, re-assessment revealed significant increase in severity of movement impairments. Post 6-week individualized HEP, a significant decrease in severity of movement impairments was found in all subjects.

**CONCLUSIONS:** In the sample studied, movement impairments existed at a high rate among yoga practitioners, and the severity increased after participation in a yoga training course. The severity of movement impairments decreased among all subjects after a targeted exercise program.

**CLINICAL RELEVANCE:** The study identified the presence of movement impairments in a regularly practicing yoga population and revealed an increased severity of these impairments following an 8-week yoga training course. This indicates that yoga may enhance faulty movement patterns present in individuals who practice regularly. The results also support the clinical use of specific exercises that effectively treated the movement impairments addressed in this study.

**OP029**

**ELECTROMYOGRAPHY ACTIVATION OF THE SHOULDER GIRdle MUSCLES DURING ABDUCTION AT DIFFERENT BODY-ORIENTATION POSITIONS**

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**PURPOSE/HYPOTHESIS:** Muscle performance deficits are therapeutically addressed via the use of resistance training [1,2]. Core components include frequency, intensity, time and type of exercise [2]. These components may be modified in different ways, including shifting the direction and rotational effect of gravity by altering the plane of motion [3]. This study assessed the effect of body position on muscle activation levels during shoulder abduction. We hypothesized that the abduction muscle demands will be affected by position in terms of peak activation level and the coincidental joint angle.

**NUMBER OF SUBJECTS:** Twelve.

**MATERIALS/METHODS:** Subjects performed shoulder abduction to 100° in 4 positions: seated, side-lying, supine, and prone. Arm movement was monitored using 3-D motion capture. Muscle demand was assessed using peak activation, in terms of percent manual muscle testing activation (percent MMT), and the coincidental shoulder joint angle. Surface EMG electrodes were placed on: posterior, middle, and anterior deltoid, upper trapezius, pectoralis major (sternal and clavicular), biceps brachii (long and short), triceps brachii (long), and latissimus dorsi muscles. Repeated ANOVA and paired t tests were used to test for significant differences between positions.

**RESULTS:** The average abduction ROM across subjects and positions was 95.7° (93°-97.5°). The magnitude of activation (pooled across all deltoids and the trapezius) was modulated significantly (P = .001) by position, with higher demands in the seated and prone (65% ± 13% MMT) versus the side-lying and supine (24% ± 8% MMT) positions. The abduction task imposed significantly higher demands on the posterior deltoid (26% MMT more) in prone and anterior deltoid in seated and supine (22% and 21% MMT more, respectively). The upper trapezius showed significant (P = .001) progressive activation across positions (13%, 27%, 66%, and 82% MMT) for side-lying, supine, prone, and seated, respectively. There were significant differences in the activation of both pectoralis portions between positions (9.5% MMT, P = .01) as well as between both heads of the biceps at different positions (P = .05). The triceps and the latissimus dorsi showed higher activation (P = .01) in prone (33% and 23% MMT, respectively). The peak activation coincidental joint angle was also different amongst the different positions.

**CONCLUSIONS:** The change of plane of motion provided a significant modulation on muscle activation demands and offers the ability to focus loading on an identified muscle or group of muscles, aiming at the improvement of muscle performance and/or the reduction of muscle imbalances [3,4]. Depending on the rehabilitation goals the change in the gravitational direction can progress the therapeutic exercise protocol from assisted to active, and thus facilitate the tissue healing process [2,4,5].

**CLINICAL RELEVANCE:** During examination, diagnosis and therapeutic exercise protocol development focusing on rehabilitating an injured joint or strengthening a muscle, it is imperative to modulate the level of activation and excursion of the muscle.

**OP030**

**WHAT ARE THE ODDS? A SERIES OF SPINE REFERRALS IN RESIDENCY TRAINING: A CASE SERIES**

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BACKGROUND AND PURPOSE: The decision-making ability of physical therapists in evaluating whether management by a physical therapist or referral to another medical professional is appropriate is well documented. Jette et al concluded that physical therapists were able to make correct decisions for patients with musculoskeletal and critical medical conditions, however the results suggested that there is a “need for further emphasis on education in medical screening, identification of red flag symptoms, and differential diagnosis.” The purpose of this case series is to highlight the identification of 3 spine cases for medical referral and the value of careful analysis of clinical reasoning strategies during specialty training.

CASE DESCRIPTION: The prevalence of serious spine pathology from a cohort of patient’s seeking primary care treatment for low back pain has been documented to be .9%. In the first 3 months of orthopaedic residency training, 6% of evaluations performed were diagnosed for medical referral. The examination of 3 of these noncritical medical referrals were analyzed due to the discrepancy in odds. All 3 patients were initially referred to a hospital-based outpatient physical therapy clinic from physicians who specialized in the spine.

OUTCOMES: Pretest probabilities were estimated from prevalence statistics. Clinical reasoning strategies were evaluated, and the diagnostic accuracy of subjective data and clinical findings were applied to calculate the post-test probability of pathology. Patient outcomes and appropriateness of referral for the 3 case examples are described.

DISCUSSION: Successful noncritical medical referral was demonstrated in these 3 patients. This case series highlights the analysis of red flag screening and the use of a consistent management model in differential diagnosis of the spine. When used in isolation, red flags have little diagnostic value. It is imperative for physical therapists to implement best-evidence reasoning strategies to appropriately screen for these pathologies so as to avoid unnecessary investigations that are themselves harmful. Despite the odds, utilizing the diagnostic accuracy of test findings to reflect back on these cases demonstrated that the clinical decision-making was consistent with what was diagnosed on imaging. This series highlights the values of reflective clinical practice with red flag screening for residency or fellowship education.


OP032
EVIDENCE BASED TREATMENT ALGORITHM FOR PATIENTS WITH A DIAGNOSED CONCUSSION: CASE STUDY
James Camarinos, George Padin
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BACKGROUND AND PURPOSE: The management of concussion injuries remains controversial, in particular decisions on when and how to intervene with targeted therapies and when rest is less beneficial than activity. Furthermore, specific examination and treatment descriptions are not readily available in many sources. There is growing evidence in utilizing a system-based classification in treating the somatic symptoms of concussion and postconcussion syndrome. The purpose of this paper is to highlight the decision making process and subsequent treatment based on system subgroups of concussion in 2 patients presenting with a similar mechanism of injury with different courses of treatment.

CASE DESCRIPTION: Two patients, both 3 weeks postconcussion were referred to an outpatient private practice. Both individuals presented with a similar mechanism of concussion injury.

OUTCOMES: Pain was assessed using a numeric pain rating scale (NPRS), symptom type and severity was measured by the Post Concussion Symptom Scale (PCSS), activity limitation was assessed using the Patient-Specific Functional Scale (PSFS), vestibular dysfunction was measured using the Vestibular/Ocular-Motor Screen (VOMS), and cardiov-
phase is the advanced phase, in which the athlete begins higher level endurance. The second phase, the intermediate phase, addresses muscle proving neuromotor control of the scapula, reducing pain, and muscular patating in track and field, tennis, and softball. Methods include use of a system-based classification approach. Functional evidence of this improvement was noted on the significant activity improvement made in the PSFS for each patient. The improvement system with directions for treatment.

**REFERENCES:**

**OP033**
THE CLINICAL MANAGEMENT OF SHOULDER PAIN AND THE SICK SCAPULA IN THE FEMALE OVERHEAD ATHLETE: A CASE SERIES REPORT

**Taryn E. Cappadona, Dale Yake, Zachary E. Walston, Carlos Johnson**

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**BACKGROUND AND PURPOSE:** The prevalence of shoulder injuries in the overhead athlete is on the rise, with an estimated 30% of athletes incurring documented shoulder injuries at some point in their athletic career. There have been a multitude of studies looking at shoulder pain in athletes, with the primary focus on baseball players. The purpose of this case series was to evaluate effective treatment strategies geared toward the female overhead athlete in a variety of settings. Specifically, this study addresses the female overhead athlete presenting with a resting malposition of the scapula known as SICK scapula, in addition to pain with participation in their respective sport.

**CASE DESCRIPTION:** The study looked at 3 young female athletes, participating in track and field, tennis, and softball. Methods include use of a specialized protocol with 4 main phases. The first phase focuses on improving neuromotor control of the scapula, reducing pain, and muscular endurance. The second phase, the intermediate phase, addresses muscle imbalances of the upper quarter as well as capsular mobility. The third phase is the advanced phase, in which the athlete begins higher level sport-specific drills. The final phase is return to sport.

**OUTCOMES:** Patients were treated 2 to 3 times per week for 12 weeks. Using this protocol, all 3 of the female athletes had a full reduction in symptoms, demonstrated normalized scapular positioning with overhead activities, and were able to have a full return to sport.

**DISCUSSION:** The overall results of this study suggests that further research is needed in this area of physical therapy in order to draw any definitive conclusions.

**REFERENCES:**

**OP034**
EFFECTS OF VIDEO AND VERBAL AUGMENTED FEEDBACK ON JUMP-LANDING ERROR

**Joe G. Carpenter**

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**PURPOSE/HYPOTHESIS:** Augmented external feedback, by visual, video review and oral instruction have been shown to improve jump-landing technique immediately following jump-landing trials and when restet-ed (without any interventions) 1 week later. This study analyzed whether augmented feedback provided over an extended period of time improved jump-landing errors.

**NUMBER OF SUBJECTS:** Fifteen (mean ± SD age; 23.5 ± 1.2 years).

**MATERIALS/METHODS:** Subjects were assigned to 1 of 3 groups: A (no feedback), B (verbal feedback), or C (iPad video and verbal feedback) for separate analysis on feedback. On day 1, all subjects completed a baseline jump-landing test, a jump landing training session, and an initial jump-landing posttest. In all testing sessions (baseline, initial posttest, final posttest), and training sessions subjects completed 3 practice jumps followed by 5 recorded jumps. For baseline testing, initial post testing, and final post testing kinet and kinematic data were collected using Qualysis 3-D motion capture systems and AMTI force plates. During jump training sessions, data were collected on 2 iPads and scored using the Landing Error Scoring System (LESS), a clinical assessment tool of jump-landing biomechanics. Following day one, each subject participated in a jump training session once a week for 3 consecutive weeks. During jump training sessions, subjects in groups B were given 2 verbal cues correlating to 2 errors the researcher believed were most prominent upon reviewing LESS found the video footage prior to feedback. Those in group C were given verbal feedback similar to group B while viewing the video on the iPads. Subjects completed a final jump-landing posttest 2 weeks after the last jump training session. A time (pre, post, final) by group (A, B, C) mixed ANOVA was performed.

**RESULTS:** No significant differences were found between groups for any of the dependent variables using a repeated measures ANOVA. Over training sessions, the control group showed little improvement on the LESS (average decrease of 0.6 errors), the verbal feedback group improved slightly (average decrease of 1.6 errors), and video and verbal group im-

**OP035**
THE EFFECTIVENESS OF USING BELT FEEDBACK TO IMPROVE JUMP-LANDING ERRORS IN YOUNG FEMALE OVERHEAD ATHLETES

**Samantha L. Barlow, Mike R. Wooten, Brian J. Gehrke**

Georgian College of Bioscience and Health Sciences,.'
proven the most (average decrease of 3.0 errors). For kinetic and kinematic data, all sagittal plane data (knee and hip flexion) and ground reaction forces relative to body weight improved for the video and verbal group over testing sessions. Video and verbal group improved more than both the control and verbal only groups in all sagittal plane and ground reaction force data.

CONCLUSIONS: Although not significant, subjects showed improvements in jump-landing error using video and verbal feedback over an extended period of time. Further studies with larger sample sizes need to be conducted to understand the best means of feedback for decreasing risk of ACL injury.

CLINICAL RELEVANCE: This study examines different means of feedback for jump landing analysis that can be used in a clinical setting. With new and evolving technologies, clinicians should be aware of the efficacy of different mechanisms for feedback.

OP035
VALIDATION OF LIMB-LOADING SYMMETRY USING WEARABLE PLANTAR PRESSURE INSERTS: APPLICATION FOR MONITORING OF DAILY LOADING
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PURPOSE/HYPOTHESIS: Persistent loading asymmetry following anterior cruciate ligament reconstruction (ACL) is a concern as it is thought to contribute to increase risk for re-injury [1-7]. Daily loading behaviors outside of formal rehabilitation may provide a strong stimulus to reinforce asymmetrical loading patterns during early recovery [8]. However, how individuals load their limbs throughout the day is not known. Recent advances in wearable technology may provide a mechanism for quantifying limb loading outside of a laboratory setting. The purpose of this study was to determine the level of agreement between force platforms and wearable pressure inserts for measurements of loading symmetry during daily activities.

NUMBER OF SUBJECTS: Seven healthy individuals (3 male) participated.

MATERIALS/METHODS: Participants performed single limb stance, sit-to-stand, stand-to-sit, and walking and a combined sit-to-stand, turning, walking and stooping tasks. Data were collected concurrently from force platforms (BTS, Milan, Italy; 1000 Hz) and shoe insert equipped with 8 pressure sensors positioned across the heel, midfoot, forefoot and toes (Orpyx, Calgary, Canada; 100 Hz). Vertical ground reaction force (vGRF) impulse was calculated from force platforms as the area under vGRF time curve for each condition. Vertical force (vF) impulse was calculated from shoe inserts. Total force from pressure sensors (PSI) was multiplied by sensor area (mm2) for each sensor and summing the forces from 8 sensors. Total force measured during a single limb stance task was used to normalize forces measured during all other experimental tasks (%BW). vF impulse was calculated as the area under the total force (%BW) time curve for each task. Symmetry indices were calculated as a ratio of non-dominant/dominant for vGRF and vF impulses. Averages of 5 symmetry indices per task per person for VGRF and vF were considered for analyses. To quantify the level of agreement between systems, concurrent validity of was determined using intraclass correlation coefficients (ICC) analyses were performed individually on each task.

RESULTS: Symmetry indices of VGRF and vF impulse ranged from vGRF: 0.03-0.19; vF: 0.05-0.17 across tasks. ICCs were 0.88 (P = .01) for sit-to-stand, 0.84 (P = .02) for stand-to-sit, 0.93 (P = .003) for walking, and 0.88 (P = .01) for continuous task.

CONCLUSIONS: ICCs greater than or equal to 0.88 indicate a high level of agreement between measurement systems for calculation of limb loading symmetry in healthy individuals during tasks that represent daily activities. The level of asymmetry between limbs measured with the gold standard force platforms ranged from 3% to 20%. The strong concurrent validity with relatively small asymmetries suggests these shoe sensors will be capable of quantifying between limb loading deficits in individuals following ACLR.

CLINICAL RELEVANCE: Wearable pressure inserts may provide valuable information for quantification of loading behaviors in individuals following ACLR in a daily basis.

OP036
THE EFFICACY OF INSTRUMENTED ASSISTED SOFT TISSUE MOBILIZATION: A SYSTEMATIC REVIEW
Scott W. Cheatham, Morey J. Kolber, William J. Hanney, Paul Salamh
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PURPOSE/HYPOTHESIS: Instrument assisted soft-tissue mobilization (IASTM) is a popular intervention for musculoskeletal pathology. Several types of instruments and approaches exist. Despite popularity, a consensus on the optimal IASTM approach has not been identified in the literature. Moreover, a paucity of research exists to establish a consensus for the efficacy of IASTM. Thus, a systematic review of the current evidence assessing the effects of IASTM as an intervention for musculoskeletal pathology or to enhance joint range of motion (ROM) was conducted.

NUMBER OF SUBJECTS: None.

MATERIALS/METHODS: A systematic search strategy was conducted according to the Preferred Reporting Items for systematic reviews and meta-analyses (PRISMA) guidelines. The following databases were searched during the month of December 2015: PubMed, PEDro, Science Direct, and EBSCOHost collection. The search terms included individual or a combination of the following: instrument assisted augmented soft-tissue mobilization Graston and technique. Studies considered for inclusion met the following criteria: (1) peer reviewed, English language publications; (2) controlled clinical trials that compared pretest and posttest measurements for an intervention program using IASTM; (3) studies that compared an intervention program using IASTM; (4) studies that compared 2 intervention programs using IASTM. Studies were excluded if they were non-English publications, clinical trials that did not directly measure the effects of IASTM, clinical trials that included Guasha and ASTM, case reports, clinical commentary, dissertations, and conference proceedings. Two reviewers participated in the review and agreed upon articles retained and excluded.

RESULTS: A total of 7 randomized controlled trials were appraised. Five studies measured an IASTM intervention versus a control or alternate intervention. The results of the studies showed improvement, albeit no significant difference between the groups (P<.05) for pain, function, strength, muscle length, and balance. Two studies measured an IASTM intervention versus a control or alternate intervention group on the effects of joint ROM via the effect of muscle length. The IASTM intervention produced significant (P<.05) short-term gains up to 24 hours.

CONCLUSIONS: The literature measuring the effects of IASTM is still emerging. The consensus of current research suggests favorable results of IASTM as a treatment for common musculoskeletal pathology however, the results are not superior to other interventions such as soft tissue mobilization or stretching. Among asymptomatic individuals there appears to be supportive evidence for IASTM as an intervention to increase short-term joint ROM with a superior effect compared to a control group (P<.001).

CLINICAL RELEVANCE: IASTM may be an effective intervention for improving joint ROM among healthy and injured individuals, however, the efficacy of this intervention for treating individuals with musculoskeletal pathology is not superior to alternative interventions.

OP037
RELIABILITY OF A PRESSURE PAIN THRESHOLD SCALE: A PRELIMINARY INVESTIGATION
Scott W. Cheatham, Morey J. Kolber, William J. Hanney,
Monique Mokha  
Kinesiology, California State University Dominguez Hills, Carson, California; Exercise and Sports Science, Nova Southeastern University, Davie, Florida; Physical Therapy, Nova Southeastern University, Davie, Florida; Physical Therapy, University of Central Florida, Orlando, Florida

**PURPOSE/HYPOTHESIS:** Manual palpation for tenderness is an examination technique used to identify tissue reactiveness, quantify severity, and assist with the diagnosis of musculoskeletal conditions. Chronic conditions such as fibromyalgia (FM) depend on the palpation examination for diagnosis since imaging and blood tests are inconclusive. Despite the widespread use of manual palpation, a consensus for reliably documenting and quantifying pressure pain thresholds (PPT) does not exist. An ordinal scale, possessing reliability, that quantifies palpable tenderness would serve useful for identifying tissue reactiveness, documentation of change, and assist with the clinical diagnosis. Thus, the purpose of this study was to determine the intrarater reliability of a 5-point ordinal scale (graded 0-4 with increasing severity) that may be used for identifying and quantifying palpable tenderness.

**NUMBER OF SUBJECTS:** Twenty participants (mean ± SD age, 43.81 ± 15.0 years) including 10 diagnosed with FM (2 male, 8 female) and 10 controls (4 male, 6 female) with no known orthopaedic pathology were recruited for this study.

**MATERIALS/METHODS:** Participants underwent a testing session using the American College of Rheumatology tender point criteria for the diagnosis of FM. The 18 predetermined tender points were selected as they are established areas of palpable tenderness, thus allowed assessment of the full range of the 5-point scale. For each tender point, the examiner graded the response using the scale (0, no tenderness; 1, reports tenderness; 2, reports tenderness and has facial expression; 3, withdraws; 4, does not allow palpation beyond superficial contact). The session was repeated within 3 days. Pressure up to 4 kg/cm² was applied at each tender point using the thumb with a digital pressure algometer. Testing stopped once the examiner reached 4 kg/cm² of pressure or once a maximum level of pressure was reached for identifying tissue reactivity, documentation of change, and assisting with the clinical diagnosis. Thus, the purpose of this study was to determine the intrarater reliability of a 5-point ordinal scale (graded 0-4 with increasing severity) that may be used for identifying and quantifying palpable tenderness.

**RESULTS:** The ordinal scale had good intrarater reliability with the FM (ICC = 0.92; CI: 0.89, 0.94) and control group (ICC = 0.91; CI: 0.88, 0.93).

**CONCLUSIONS:** The results provide preliminary evidence of reliability for an ordinal scale that may be used for quantifying palpable tenderness. Further research should determine the diagnostic accuracy of the PPT scale as well as the minimum threshold cut point to determine tenderness associated with pathology.

**CLINICAL RELEVANCE:** The development and utilization of a reliable PPT scale may have clinical applications for identifying tissue reactiveness, quantifying tenderness, documenting change, as well as assisting with the clinical diagnosis.

**Examina**

**Examination of First and Second Landings of Drop Jumps with a Single Session of Jump-Landing Training**

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**PURPOSE/HYPOTHESIS:** Analyses of vertical jump and rebound landing techniques are used to identify and decrease risk of knee injury. Techniques are generally examined only for the first landing although 2 landings are involved in these jumps. Recent evidence suggests that the second landing should also be assessed but the findings were only applied to a one-time testing session with no training performed. Therefore, the purpose of this study was to examine the kinematics and kinetics of both landings before and after a single training session with augmented feedback.

**NUMBER OF SUBJECTS:** Fifteen (mean ± SD age, 23.5 ± 1.2 years).

**MATERIALS/METHODS:** Subjects were randomly assigned to 1 of 3 groups (Grp): A (control-no feedback), B (verbal feedback), or C (iPad video-verbal feedback). All subjects completed an initial jump-landing reboun test followed by a jump training session. Subjects completed weekly jump-landing training sessions for 4 weeks. A week following the final training session, posttesting was done with the same methods as pretest. Subjects landed onto 2 force plates from a 30-cm-high box such that 1 foot hit each plate. Upon landing they immediately rebounded for a maximal vertical jump and a second landing onto the force plates. After practice, 5 jump trials were recorded. Peak vertical ground reaction forces normalized to body weight (Fz), hip, knee and ankle joint angles at initial plate contact (IC) and joint excursions (ROM) were analyzed as first-second landing ratios. Training sessions consisted of 3 practice jumps and 5 trial jumps with feedback given twice within each session. Verbal feedback provided to the Grp B and C focused on 2 errors that the researchers believed were most prominent in reviewing the video footage between jumps. Grp C was also provided with video feedback. A time (pre, post)-by-group (A,B,C) mixed ANOVA was performed.

**RESULTS:** Fz ratios ranged from 1.03 ± 0.18 (Grp B; pre) to 1.31 ± 0.41 (Grp B; post). There was a trend towards significant interaction (P = 0.056) between pre and posttesting and groups (1.22-1.18; 1.04-1.3; 1.12-0.96; pre-post and groups A, B and C, respectively). There was a significant main effect (P = .048) for the knee flexion ratio at IC with ratios less than 1 for A and B but 1.97 for C. There was also a significant main effect of time (pre-post) for ankle sagittal joint excursion (P = .017) with ratios 1.16 (pre) and 1.07 (post) regardless of group.

**CONCLUSIONS:** The differences in ratios for different variables, groups and testing sessions findings indicate that the second landing should be considered when examining vertical jump and/or rebound landing techniques. As the findings were consistent across training groups, both landings should be examined when training activities are utilized.

**CLINICAL RELEVANCE:** Jump landings are being used clinically with assessment tools to determine risk of knee injury. Often the second landing is either ignored or not assessed similarly to the first. This study supports that the second landing be examined when training sessions are performed.
alyzed using Visual3D software. Peak vertical ground reaction forces normalized to body weight (Fz), hip, knee and ankle joint angles at initial plate contact (IC) and joint excursions (ROM) were analyzed as first-second landing ratios. The training session consisted of practice jumps and 5 trial jumps with verbal feedback given to Grp B and verbal+video feedback to Grp C. A time (pre, post)-by-group (A,B,C) mixed ANOVA was performed.

RESULTS: There were no significant interaction and main effects for Fz ratios, angles at IC and joint excursions. However, there was a trend towards significance for Time main effect for knee ROM ratio (P = .064). Subjects had more similar knee ROM during post (1.01 ± 0.05) compared to pre (1.06 ± 0.04). Fz ratios ranged from 1.04 ± 0.16 (Grp B; pre) to 1.3 ± 0.17 (Grp A; post) and slightly increased from pre-to-post testing (1.2-1.3; 1.04-1.18; 1.12-1.13 for Grp A, B, and C, respectively). Ratios for sagittal joint angle excursion, were mostly around 1. Ratios for sagittal angle at IC ranged from 0.96 (Knee Grp C; pre) to 5.4 (Ankle Grp C; pre). There was more variability in the hip and frontal plane ratios with range of 0.33 (Knee Grp B; post) to 2.9 (Hip Grp B; pre).

CONCLUSIONS: The near 1:1 ratios for Fz and sagittal plane angles as well as variability seen in knee and hip frontal plane angles indicate that the second landing should be considered when examining vertical jump and/or rebound landinging techniques. As the findings were consistent across training groups, both landings should be examined when training activities are utilized.

CLINICAL RELEVANCE: Jump landings are being used clinically with assessment tools to determine risk of knee injury. Often the second landing is either ignored or not assessed in the same manner as the first. This study supports that the second landing be examined regardless if the assessment is one-time or with training sessions.

OP040

THE ASSOCIATION OF PHYSICAL ACTIVITY WITH OUTPATIENT PHYSICAL THERAPY UTILIZATION AFTER TOTAL KNEE REPLACEMENT

Meredith B. Christiansen, Louise M. Thoma, Hiral Master, Robert Cowley, Emily Polakowski, Laura A. Schmitt, Daniel Rhon, Daniel White

PURPOSE/HYPOTHESIS: While standard postoperative care includes a 3-day discharge after surgery for Total Knee Replacement (TKR), utilization of outpatient physical therapy (PT) remains highly variable [1]. It is unclear why this occurs, preoperative and postoperative levels of physical activity (PA) may be an important predictor of utilization, though little is known about this association. The purpose of this study, therefore, was to explore the association of presurgical and postsurgical PA levels with subsequent utilization of PT services in people after TKR.

NUMBER OF SUBJECTS: Forty-five participants receiving standardized PT care for a unilateral TKR at a University PT clinic between September 2015 and May 2016.

MATERIALS/METHODS: We utilized data from an ongoing pilot study of PA after TKR. Presurgical (pre-TKR) PA was measured using self-report at the initial PT evaluation in response to the question, “What was your pre-injury physical activity level?” Response choices including predominantly sedentary or sitting with some standing were classified as Light pre-TKR PA, while walking, some handling of material or heavy manual work were classified as Moderate pre-TKR PA. Postsurgical (post-TKR) PA was objectively measured as steps per day using an accelerometer (Actigraph GT3X) worn by the participant for the first week of PT. We categorized less than 2500 steps/d as Light post-TKA PA, and greater than 2500 steps/d as Moderate post-TKR. Utilization of PT was defined as the total number of PT visits (frequency) and the number of days of service from admission to discharge (duration). Participants were classified as high or low utilizers based on the mean values of frequency and duration of PT. We explored the association of pre- and post-TKR PA (Light versus Moderate PA) with high versus low utilizers, with unadjusted odds ratio (OR) and 95% confidence intervals (CIs).

RESULTS: We used data from 32 participants (mean ± SD age, 65 ± 9 years; 56% female; BMI, 33 ± 7.5 kg/m² who had 21 ± 6 PT appointments and 68 ± 23 days of PT. Participants with Light Pre-TKR PA were 1.5 times more likely to be high frequency of PT (95% CI: 0.34, 6.53) and 2.0 times as likely to have a long duration of PT (95% CI: 0.46, 8.77) compared with those who with Moderate pre-TKR PA. Those with Light-post-TKA PA were half as likely to have a high frequency of PT OR = 0.5 (95% CI: 0.11, 2.32) and 25% less likely to have a long duration of PT (OR = 0.75; 95% CI: 0.17, 3.27) compared with those with Moderate post-TKR PA.

CONCLUSIONS: PA before and after surgery may be an important marker of the frequency and duration of the utilization of PT after TKR. We found people who reported less active pre-TKR PA tend to be high utilizers of PT services. Conversely, participants who were less active post-TKR tend to be low utilizers of PT services. Our study conclusions are preliminary given our small sample size.

CLINICAL RELEVANCE: Measuring PA after TKR may help to plan for the utilization of PT after TKR.
INPECTORALIS MAJOR RUPTURES, DOES SURGICAL OR NONSURGICAL INTERVENTION PRODUCE BETTER STRENGTH OUTCOMES? A SYSTEMATIC REVIEW

Nathan Church, Coby Nattier, Morgan Stemple, Tom Sneed
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PURPOSE/HYPOTHESIS: In today’s American culture, physical fitness and appearance is greatly valued. Weightlifting has been popularized as has other high level sporting and fitness activities. With this greater population of athletes, more uncommon injuries are being noted as well to include pectoralis major muscle rupture. Unlike typical musculoskeletal injuries, a well defined standard of care has not been established for pectoralis major rupture. Nonsurgical treatment has limited studies on incomplete ruptures focused on the geriatric population. Surgical treatment has been researched with a focus on which technique gives best outcomes. Cosmesis, pain reduction, and overall satisfaction are good outcomes but strength leading to return of function is most valuable. With this basic information regarding pectoralis major rupture, physical therapists must be able to answer the question which leads to better strength outcomes, surgical or nonsurgical intervention?

NUMBER OF SUBJECTS: Ninety-two.

MATERIALS/METHODS: In February 2016 databases CINAHL, Cochrane, MEDLINE, and SPORTDiscus were searched using the terms, “pectoralis major rupture OR pectoralis major tear AND treatment.” Limiting of original studies focused on surgical intervention lead to peak torque of 74% to 110% of uninvolved side with nonsurgical intervention and 44 had nonsurgical intervention. One study reported 6 nonsurgical went on to have surgery. Strength outcome revealed surgical intervention lead to peak torque of 74% to 110% of uninvolved side while nonsurgical intervention lead to only 56% to 75% of uninvolved side.

RESULTS: All 4 studies were identified as level IV research. Three studies were cases series and 1 was a cohort series. All 4 studies received a quality of study score of 5/7. This score results in studies showing moderate strength of evidence. From the 4 studies, 48 pectoralis majors had surgical intervention and 44 had nonsurgical intervention. One study reported 6 nonsurgical went on to have surgery. Strength outcome revealed surgical intervention lead to peak torque of 74% to 110% of uninvolved side while nonsurgical intervention lead to only 56% to 75% of uninvolved side.

CONCLUSIONS: Overwhelmingly surgery was far better for rupture. Strength outcome alone shows an 18% to 35% greater improvement in surgical intervention. Additional subjective outcome measures studied also demonstrated greater outcomes which include cosmesis, pain, and overall satisfaction.

CLINICAL RELEVANCE: With surgical intervention obviously superior for strength outcome in complete ruptures, perhaps what is now more glaring is the gap in knowledge and evidence of how varying degrees of partial tear will best respond to surgical versus nonsurgical intervention. Additionally, how might the physical therapist accurately identify patients who require surgery versus those who would best respond to a nonsurgical approach to rehabilitation? Clearly, these are the questions future research needs to answer.

Differential Diagnosis of Right Flank Pain in a Patient with Gilbert’s Syndrome and Persistent Cough: A Case Study Report

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BACKGROUND AND PURPOSE: Evaluating the source of a patient’s pain in the right flank region can be difficult, especially when complicated by mechanical complaints and comorbidities. A clinician must consider ribs, accessory breathing musculature, abdominals, and visceral referral patterns. Gilbert’s Syndrome is a condition that alters bilirubin metabolism and effects an estimated 3% to 7% of the population. The purpose of this poster is to describe the clinical decision-making process for a patient with right flank pain after upper respiratory infection.

CASE DESCRIPTION: The patient is a 44-year-old man with Gilbert’s syndrome that presented with a 3 week presence of right flank pain that began following an upper respiratory infection and severe coughing. The referring physician diagnosed the patient with a diaphragm strain. The patient reports minimal medical management of Gilbert’s syndrome and describes current symptoms as different than previous liver related pain. Chief complaints included coughing, lying supine, prone or on ipsilateral side, bed mobility, and sexual activity. Initial examination revealed signs and symptoms consistent with muscular strain with no abdominal tenderness or pain related to recent eating or drinking habits. Testing showed pain with end range lumbar spine flexion, tenderness to palpation of anterolateral ribs 8 to 10, and pain with supine curl-up. Flank pain improved quickly, but continued to persist for 1.5 weeks. The patient returned after 15 days with minimal coughing, but significantly increased right flank pain. The patient reports the preceding days included increased driving, alcohol consumption, and poor diet habits including increased fat intake. At this time assessment shows pain with right upper-quarter pain with deep palpation and led to a decision to refer back to referring provider. To note, original signs of pain with curl up and rib tenderness persisted.

OUTCOMES: The patient was referred back to his primary care physician who completed a metabolic panel and ultrasound. Results demonstrated no hepatic abnormality, but show a 3-mm gallstone and high bilirubin levels.

DISCUSSION: This case demonstrates the importance of ongoing reevaluation for individuals with Gilbert’s syndrome and right flank pain, even if initial physical therapy testing suggests musculoskeletal origin.

Combined Sections Meeting


**OP045**

THE LAST ENCOUNTER: DIAGNOSTIC EXAMINATION AND MANAGEMENT OF A PATIENT WITH ABDOMINAL PAIN

Lauren Clark, Jason Beneciuk, Robert Rowe

Physical Therapy, Brooks Rehabilitation, Orlando, Florida

**BACKGROUND AND PURPOSE:** Patients who present to physicians with abdominal quadrant pain are often referred to other medical doctors to rule-out visceral pathologies; however injuries to the abdominal musculature commonly present as symptoms in the abdominal region and may be appropriate for physical therapy management. These injuries commonly occur in athletes who perform unbalanced eccentric trunk rotations such as golfers; therefore it is important for clinicians to consider perpetuating factors that may have predisposed the athlete to injury and intervention strategies that will be most useful for resolution of symptoms and return to function. The purpose of this case report is to describe the use of exercise combined with thoracolumbar region targeted manual therapy to address abdominal pain in a recreational golfer.

**CASE DESCRIPTION:** A 63-year-old man presented to physical therapy with a 16-month history of right lower quadrant pain that radiated to the upper quadrant with difficulty performing lumbar rotational and flexion movements such as golfing and household tasks. The patient had previously been evaluated by multiple medical providers and underwent surgical cholecystectomy and kidney stone procedures with no relief of symptoms. He demonstrated muscular guarding and poor coordination of muscles of active spinal stabilization. Clinical outcome measures consisted of the Modified Oswestry Low Back Pain Questionnaire (ODI), numeric pain rating scale (NPRS), and the Patient-Specific Functional Scale (PSFS) administered at intake and 6 weeks. Interventions included coordination training for the thoracolumbar region and joint mobilizations to restore necessary dynamic movement patterns necessary for golfing and household tasks.

**OUTCOMES:** Following 7 weeks of physical therapy the patient demonstrated the ability to perform pain free movement patterns necessary for golfing and household activities and was able to participate in a graded return to golf at his desired frequency of 5 days a week. Improvements in NPRS (4 to 0), ODI (18% to 6%), and PSFS (5.5 to 7) scores were also observed, meeting minimal clinically important differences for pain and low back pain related function.

**DISCUSSION:** With increased direct access opportunities, it is vitally important for physical therapists to become efficient in medical screening and clinical decision making to distinguish between orthopaedic and visceral conditions. Upon examination, reproduction of symptoms occurred with thoracic and lumbar movements in the transverse and sagittal planes which increased confidence that symptoms were of musculoskeletal origin. Abdominal wall injuries may occur in patients who participate in repetitive movements of the lumbar spine and are appropriate for physical therapy treatment when considering muscular coordination, movement, and loading. Screening for movement disorders that present as abdominal pain is an important component to physical therapy management which has the potential to limit unnecessary health care utilization and improve patient outcomes.


**OP046**

NONINJECTABLE NEEDLING INTERVENTIONS FOR SHOULDER PAIN CONSISTENT WITH IMPINGEMENT SYNDROME: A SYSTEMATIC REVIEW

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**PURPOSE/HYPOTHESIS:** Subacromial impingement syndrome (SIS) is one of the more common disorders of the musculoskeletal system. Shoulder pain accounts for one third of physician office visits for musculoskeletal pain and the most frequent cause of shoulder pain is SIS. Though SIS is commonly associated with biomechanical and anatomical impairments, there have been a few studies published recently that demonstrate an association with soft tissue dysfunction and SIS. An APTA paper indicated a limited number of studies that included dry needling as a primary intervention for soft tissue dysfunction. The purpose of this systematic review was to synthesize and investigate the use of non injectable needling intervention strategies for the management of SIS.

**NUMBER OF SUBJECTS:** Nine randomized controlled trials and 307 subjects total were included in this review.

**MATERIALS/METHODS:** A systematic literature review consistent with the PRISMA guidelines was used to investigate the use of needling intervention strategies for SIS. All studies that investigated patients with shoulder pain consistent with SIS were included. Included techniques were those related to needling strategies where a non injectable needle approach was used targeting the shoulder complex with a specific focus on treatment of muscle tissue.

**RESULTS:** Five trials that investigated the use of acupuncture and 4 trials that investigated the use of dry needling were included in this review. The PEDro risk of bias assessment tool was used. The average PEDro score for the acupuncture trials was 5.4. The average PEDro score for dry needling trials was 7.25. Included trials varied in the treatment intent and the type of outcome measures used and therefore only qualitative analysis could be performed. Pain pressure threshold (PPT) was included for all 4 studies focused on dry needling trials and all 4 trials had significant within group increased PPT. For the measure of pain, all trials demonstrated significant within group changes in pain. However, between group differences were only noted at immediate and 1 week.

**CONCLUSIONS:** The findings from this systematic review provide insight regarding the emerging effectiveness of dry needling. Both muscle tissue directed acupuncture and dry needling does appear to have immediate and short term effects on pain and PPT. However, none of the studies reported on long term effectiveness. There was inconsistency in the use of outcome measures to make a conclusion about effect on function. The type of needling strategy used was also inconsistent and the descriptions of technique were often limited.

**CLINICAL RELEVANCE:** The use of dry needling intervention strategies is becoming widely used in physical therapy practice. The findings from this systematic review suggest that there might be an effect on pain and PPT both immediate and short term for SIS. There were no studies that looked at long term outcomes; therefore it is recommended if the clinician uses...
dry needling that it is incorporated into a treatment package that includes evidence supported interventions.

**OP047**

**DOES THE PRESENCE OF RADIATING PAIN IN A COHORT OF CARE-SEEKING PATIENTS WITH BACK PAIN INFLUENCE OUTCOME?**

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**PURPOSE/HYPOTHESIS:** Previous literature has established the presence of radiating pain in patients with low back pain as a prognostic indicator for worse outcome. This finding has been included in screening tools for low back pain such as the START Back Tool. The purpose of this analysis of a cohort of patients is to establish if difference exists in duration of care and outcomes in patients presenting to physical therapy with nonradiating and radiating low back pain.

**NUMBER OF SUBJECTS:** The study involves 368 patients with back pain with or without radiating low extremity symptoms who received guideline oriented care by physical therapists over a 3-year period.

**MATERIALS/METHODS:** The data included patients who were seen via direct access or through referral. Baseline measures of pain, disability (Oswestry disability index [ODI]), depression and quality of life were captured for each subject. Final outcomes measures captured include pain and the ODI. Comparative analyses between groups were performed for all baseline measures (using a r test/chi-square) and for discharge percentage change scores for pain and disability (using an analysis of covariance [ANCOVA]; α = .05).

**RESULTS:** Of the 368 patients enrolled, 256 (69.5%) had low back pain without radiation and 112 (30.5%) had radiating symptoms. No differences existed in baseline age, BMI, or baseline quality of life scores of patients in each group. Differences existed in number of PT session with those with radiating symptoms being seen 1.39 more visits (P = .011). Baseline pain and disability were not significantly different, nor was reductions in disability between groups.

**CONCLUSIONS:** Despite the commonly accepted belief that the presence of radiating lower extremity symptoms in patients with low back pain is indicative of worse outcome, our findings did not support this. This difference may be due to continued visits if the patient demonstrated progression of symptoms where prior research has limited the number of PT visits. This suggests that a capitated number of visits for all patients is not an effective strategy to determine if conservative treatment is definitive for all patients.

**CLINICAL RELEVANCE:** Clinicians should consider that some patients radiating symptoms may have different lengths in episode of care but can be expected to reach similar functional levels at discharge.

**OP048**

**THE EFFECTS OF CORE STABILIZATION EXERCISE ON DISABILITY IN THE TREATMENT OF NONSPECIFIC LOW BACK PAIN AS COMPARED TO OTHER FORMS OF EXERCISE: A SYSTEMATIC REVIEW**

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**PURPOSE/HYPOTHESIS:** Studies suggest that between 50% to 70% of Americans will be diagnosed with some type of low back pain (LBP) during adulthood. Risk factors for LBP include weakness and lack of motor control of the trunk and abdominal muscles. Core stabilization exercises (CSE) are a more recent approach to treating LBP. These exercises are based on research indicating that impairments in motor control of the deep abdominal muscles, including the transverse abdominis and lumbar multifidus, may be an underlying cause of LBP. The purpose of this systematic review is to measure the effects of CSE in the treatment of non-specific LBP as compared to other forms of exercise utilizing the Oswestry Disability Index.

**NUMBER OF SUBJECTS:** Six studies.

**MATERIALS/METHODS:** The PubMed database was searched in January 2016 with no date limitations using various terminology for LBP and stabilization treatment protocols. Specific search terms included “lumbar,” “core stability exercise,” and “Oswestry,” searched alone and in combination. The electronic limit included the use of clinical trial studies. The inclusion criteria specified the use of the ODI as an outcome measure and the use of studies that compare CSE that activate the TrA and LM with other forms of exercise. The exclusion criteria specified studies that compare CSE to manual therapy, modalities, or surgical intervention. Study quality was assessed using the PEDro Scale and CEBM Level of Evidence.

**RESULTS:** Twenty-five articles were identified through the electronic screening process. After the title screen, abstract screen, and inclusion/ exclusion screen, 6 articles met the criteria for inclusion in this systematic review. The mean PEDro score was 5.5/10, ranging from 4/10 to 8/10. The frequency of CEBM levels included 2 level II studies, 2 level III studies, 2 level IV studies.

**CONCLUSIONS:** Three out of 6 studies with the highest level of evidence and best internal validity indicated a statistically significant improvement with CSE as compared to strengthening, conventional exercises, and stretching exercises. Two of the 6 articles resulted in no significant difference in the ODI compared to the Movement System Impairment-Based Treatment (MSI) and traditional trunk exercise, and 1 article indicated evidence that “Global Postural Reeducation” (GPR) may be significantly better than CSE. All participants in the studies reviewed showed significant within-group improvements in ODI scores after participation in CSE.

**CLINICAL RELEVANCE:** Based on the findings in this systematic review, CSE should be considered as a viable exercise option in the treatment of LBP. Overall, the evidence in these studies was graded as a “B” due to a mixture of moderate to strong CEBM levels and PEDro scores.

**OP049**

**EFFECTS OF NOVEL DEVICE-SUPPORTED NEUTRAL SPINAL SITTING IN INDIVIDUALS WITH LOW BACK PAIN: A RANDOMIZED CONTROLLED TRIAL**

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**PURPOSE/HYPOTHESIS:** Sitting is a predominant work posture. Without muscle action or external support, sitting leads to a posterior pelvic tilt and a decreased lumbar lordosis, at times leading to low back pain (LBP). Sitting in a neutral spinal posture is preferred. There are currently no studies known that examined neutral sitting posture in adults with LBP for greater than 48 hours. This study investigated the effects of supporting neutral sitting posture via a novel pelvic support device over 3 weeks in an adult population with LBP and a seated occupation. It was hypothesized that the subjects who utilized the device would have significant improvements in pain, functional tolerance, ROM and strength.

**NUMBER OF SUBJECTS:** Fifteen.

**MATERIALS/METHODS:** Fifteen subjects between ages 20 and 65 with LBP who sat at a desk 25 or more hours/week were randomized into 2 groups: 8 subjects in the experimental group utilized the pelvic support device in their chair at their workplace during the trial and 7 subjects in the control group continued in their current desk set-up with no changes. Preoutcome and postoutcome measures included: Modified Oswestry Disability Index (ODI), numeric pain rating scale (NPRS), the fingertip to floor and Sorensen tests and hamstring extensibility. The device uti-
lized is a portable unit that takes the shape of a 3-D triangle, is covered by a nonskid surface and has a cut out in the region of the coccyx for pressure relief. It is placed on the seat just posterior and caudal to the user’s ischi al tuberosities. Through its shape and placement, it helps keep the pelvis from posteriorly rotating and aids in keeping the lumbar spine in a more neutral posture. Conflict of Interest (COI): The US patented devices used in this study are owned by Posture and Purpose, LLC. Patricia Connors, the Principal Investigator (PI) in this study, is majority owner of Posture and Purpose and invented the pelvic support device. For control of COI, the PI did not participate in any subject screening, consenting or clinical measures and all data were coded concealing group assignment until the completion of all data analysis.

RESULTS: There were significant improvements in ODI and the averaged NPRS measures. MCID was also attained for ODI. There were no significant changes in any of the physical measures.

CONCLUSIONS: The findings provide preliminary evidence that external support of neutral spinal position from the pelvis in sitting has a positive effect on self-reported pain and functional tolerance levels in adults with LBP over a 3-week period. Changes in ROM and strength do not appear associated with this postural change in the time frame investigated.

CLINICAL RELEVANCE: Identifying effective options to support neutral spinal sitting posture, while minimizing passive strain on spinal structures and limiting the muscle activity needed to maintain this posture that can lead to fatigue, would be of benefit for the sitting health of individuals with and without LBP. This study demonstrates preliminary evidence that direct support at the pelvis may be an effective strategy.

OP050

CLINICAL EFFICACY AND SAFETY OF AN EARLY HOME EXERCISE PROGRAM AFTER ANTERIOR CERVICAL DISCECTOMY AND FUSION: A CASE SERIES

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PURPOSE/HYPOTHESIS: Anterior cervical discectomy and fusion (ACDF) is the most common surgery for cervical spine conditions. Poor outcomes after ACDF have been linked to impaired muscle functioning from postsurgical disuse and deconditioning. Postoperative exercise can counteract the effects of deconditioning and promote an increase in self-efficacy. To date, no study has determined whether performance of an early home exercise program (HEP) is safe and efficacious for improving ACDF outcomes. The purpose of this case series is to describe the clinical efficacy and safety of an early HEP performed within the first 6 weeks after ACDF.

NUMBER OF SUBJECTS: Five consecutive patients (mean ± SD age, 53.0 ± 12.4 years; 4 female) who underwent ACDF were enrolled.

MATERIALS/METHODS: Patients were given a 6-week HEP to be started immediately following hospital discharge after ACDF. The HEP intervention included daily walking, deep breathing, distraction techniques, cervical (limited to 30°) and upper body range of motion, cervical and shoulder isometrics, abdominal strengthening, and shoulder theraband exercises. Compliance (eg days completing exercise) and adverse events during the 6-week exercise phase were monitored using a diary log and weekly calls with a physical therapist. Patient-reported outcomes for neck and arm pain (Numeric Rating Scale), disability (Neck Disability Index), and physical and mental health (SF-12) were assessed preoperatively, after completing the HEP (6 weeks after surgery) and at 6-month follow-up. Self-efficacy (Pain Self-Efficacy Questionnaire) was measured at baseline, 6 weeks, and 6 months after surgery. Minimal clinically important differences were used to determine meaningful change in pain (2.6 points), disability (7.5 points), physical (6.1 points) and mental health (4.7 points), and self-efficacy (11 points). Safety was assessed with radiographic imaging at 6 months.

RESULTS: After surgery and the early HEP, a majority of patients reported meaningful change in disability (4 patients at 6 weeks; 5 patients at 6 months), arm pain (4 patients at 6 weeks and 6 months), neck pain (4 patients at 6 weeks; 3 patients at 6 months), and self-efficacy (3 patients at 6 weeks and 6 months). Two patients reported meaningful change in mental health at 6 weeks and 6 months. Only 1 patient reported meaningful change in physical health at 6 months. No adverse events were reported during the 6-week exercise phase. The average number of days performing exercises was 33 days (79% of the 6-week period) with a range of 27 to 37 days (64%-83%). Radiographic imaging did not show any signs of abnormal healing after fusion.

CONCLUSIONS: The findings of this case series suggest that an early HEP can be safely implemented immediately after surgery and may positively affect ACDF outcomes.

CLINICAL RELEVANCE: These data support the early implementation of exercise after cervical spine fusion surgery with potential long-term benefits and no apparent safety concerns. Future trials will determine the effectiveness of an early HEP after ACDF.

OP051

EFFICACY OF MECHANICAL DIAGNOSIS AND THERAPY IN PATIENTS WITH CHRONIC NONSPECIFIC LOW BACK PAIN: A RANDOMIZED PLACEBO-CONTROLLED TRIAL

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PURPOSE/HYPOTHESIS: The McKenzie Method, also defined as “Mechanical Diagnosis and Therapy (MDT)” is commonly used in treatment patients with chronic low back pain (CLBP). This intervention has never been compared to a placebo treatment. We conducted a randomized placebo-controlled trial with 148 seeking care patients with CLBP to evaluate the efficacy of MDT.

NUMBER OF SUBJECTS: One hundred forty-eight.

MATERIALS/METHODS: This study was conducted in the outpatient physical therapy clinic of the Universidade Cidade de São Paulo, Brazil. Patients were randomly allocated through a computer system to either MDT (n = 74) or placebo (n = 74). The allocation was concealed. Patients from both groups received 10 treatment sessions, twice a week, for 30 to 40 minutes of session duration. The patients of MDT group were treated according to the principles of the MDT method. Patients allocated to the placebo group were treated with detuned pulsed ultrasound and shortwave diathermy. Patients from both groups also received an educational booklet. Clinical outcomes were obtained by a blinded assessor after treatment and at 3, 6 and 12 months after randomization. Primary outcomes were pain intensity and disability after the treatment. It was not possible to blind the therapists and patients to the conditions of treatment. The statistical analysis was conducted in 74 patients from MDT group and 73 from placebo group.

RESULTS: The MDT group had greater improvements in pain intensity at 5 weeks; mean effect, −1.0 point (95% CI: −2.09, −0.01) but not for disability (−0.84 point; 95% CI: −2.62, 0.93). Patients did not report any adverse events. We have not detected any between-group statistical significance for all secondary outcomes.

CONCLUSIONS: We concluded that MDT method was slightly more effective than placebo for pain intensity, but not for disability immediately after treatment in patients with CLBP.

CLINICAL RELEVANCE: We considered that the magnitude of the difference of pain found in this study is small and possibly of doubtful clinical importance.
OP052

THE EFFECTS OF MANUAL THERAPY ON FUNCTIONAL OUTCOMES AND PAIN IN PATIENTS WITH HIP OSTEOARTHRITIS: A SYSTEMATIC REVIEW
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PURPOSE/HYPOTHESIS: Hip osteoarthritis (OA) is a degenerative condition that has been shown to produce pain and affect physical functioning in patients, becoming more debilitating as the condition progresses. With these difficulties, patients struggle with quality of life and productivity, as well as the cost burden of conservative and surgical treatments. While there is no cure for hip OA, manual physical therapy may be a viable treatment to reduce symptoms and increase patients’ quality of life. The purpose of this systematic review is to determine whether manual therapy has a positive effect on functional outcomes or pain when treating patients with hip osteoarthritis.

NUMBER OF SUBJECTS: Not applicable.
MATERIALS/METHODS: The following databases were systematically searched: CINAHL, Complete SPORTDiscus with full text, MEDLINE, MEDLINE with full text, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, and Cochrane Methodology Register. The keywords used were “hip osteoarthritis,” “manual therapy,” “hip mobilization,” “hip mobilization,” “hip joint mobilizations,” “hip joint mobilization,” “hip joint mobilization,” and “hip joint mobilization.” Studies that were identified as appropriate for this review were assessed for quality using the PEDro scale.

RESULTS: The initial search yielded 126 articles which were then filtered by the authors and after excluding duplicates, 76 articles were left for title search. After a title and abstract search and reference search through a systematic review, 5 articles were chosen for this review. All 5 of the articles were deemed high quality using the PEDro scale. Therefore 5 studies looking at manual therapy for patients with hip osteoarthritis were included in this review. Two of the reviewed studies utilized the WOMAC to measure improvement in function and showed benefits when using manual therapy. A third reviewed study that utilized the WOMAC did show improvements in function, but the results were not statistically significant. The final 2 studies reviewed utilized pain as a functional outcome measure, and both showed benefits in patient’s functional pain levels when utilizing manual therapy.

CONCLUSIONS: Manual therapy, especially when combined with other treatments, should be considered as interventions for improving functional outcomes and pain in patients with hip OA.

CLINICAL RELEVANCE: Physical therapists should incorporate manual therapy within their comprehensive treatment program to improve functional outcomes and reduce pain in patients with hip OA. While manual therapy has been shown to improve outcomes, it should not be used in isolation, but rather as a supplement to other treatments such as exercise and patient education.

OP053

EFFECT OF CONTINUUM OF CARE ON PATIENT OUTCOMES AND COMPLIANCE IN PEDIATRIC PATIENTS WITH ANTERIOR HIP PAIN: A RETROSPECTIVE REVIEW
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PURPOSE/HYPOTHESIS: A positive relationship between therapist and patient has been shown to influence patient compliance, satisfaction, and outcomes with therapy [1-4]. As part of this relationship, many physical therapists feel that a good continuum of care is important to effectively treat their patients; however, it can be difficult to maintain this continuum in a busy clinic. While patient satisfaction has been linked to a good continuum of care [5-6], it is currently unknown if a poor continuum of care affects patient outcomes. We hypothesized that the more therapists involved in care would result in worse patient outcomes and reduced compliance. The primary objective of this study was to assess the effect of the number of treating therapists involved in an episode of care on patient outcomes. The secondary objective was to assess its effect on patient compliance.

NUMBER OF SUBJECTS: From a retrospective database of patients with anterior hip pain, 104 patients (mean ± SD age, 14.3 ± 2.2 years) met the inclusion criteria.

MATERIALS/METHODS: This was a retrospective study consisting of the review of each patient’s medical chart. The information was obtained from a database of patients with anterior hip pain, treated between 2010 and 2015 at a pediatric sports and orthopaedic physical therapy department. The number of therapists who treated each patient was the independent variable. Reduction in pain per visit, change in patient self-reported outcome measures, and patient compliance with therapy were the dependent variables. Compliance was defined as attending approximately 75% of visits outlined in the therapist’s most recent plan of care. The covariates were duration of symptoms and initial pain levels. Data analysis: an analysis of covariance assessed the primary outcome and a chi-squared analysis calculated the secondary outcome.

RESULTS: The mean ± SD reduction of pain per visit was 0.64 ± 0.39. Two or fewer therapists involved in care resulted in significantly greater reductions in pain (mean difference, 0.30; 95% CI: 0.01, 0.59; P = .038 for 2 therapists and 0.3053; 95% CI: –0.0009, 0.616; P = .051 for 1 therapist). The number of patients compliant with care was 111 (67.7%). No significant differences were noted between the number of therapists involved in care and compliance (P = .094). Patient self-reported outcome measures were evaluated, but no results could be derived due to approximately 75% of patients lacking outcome measures data.

CONCLUSIONS: Having 2 or less therapists involved in a patient’s care was associated with significantly greater reductions of pain. The number of therapists involved had no significant effect on compliance.

CLINICAL RELEVANCE: Maintaining a continuum of care of 2 or less therapists shows superior reduction in pain levels then having 3 or more therapists involved. This study gives support to the potential benefit of maintaining a good continuum of care to achieve optimal improvement in our patient’s pain levels.

OP054

DIAGNOSTIC IMAGING IN A DIRECT-ACCESS SPORTS PHYSICAL THERAPY CLINIC: A 2-YEAR RETROSPECTIVE PRACTICE ANALYSIS
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PURPOSE/HYPOTHESIS: The primary objective of this study is to describe the appropriateness of magnetic resonance imaging (MRI) or magnetic resonance arthrogram (MRA) exams ordered by physical therapists in a direct-access sports physical therapy clinic. Secondary objectives are to describe the utilization rates of diagnostic imaging, describe the diagnostic accuracy of the physical therapist’s clinical examination compared to MRI findings and, if applicable, surgical findings, and to compare utilization, appropriateness, and diagnostic accuracy between board certified physical therapists and nonboard certified physical therapists. We hypothesized that: (1) greater than 80% of advanced diagnostic imaging orders will comply with American College of Radiology (ACR) Appropriateness Criteria (ACR rating greater than 6); (2) all physical therapists will utilize imaging at rates equal to or lower than previously published data; (3) agreement between the clinical examination diagnosis and the MRI/sur-
gical diagnosis will be greater than 75%; (4) board-certified physical therapists will utilize diagnostic imaging at lower rates and with increased appropriateness based on ACR criteria.

**NUMBER OF SUBJECTS:** One hundred eight patients with MRI/MRA examinations ordered by a physical therapist.

**MATERIALS/METHODS:** The study design was a 2-year retrospective practice analysis. A board-certified radiologist determined the appropriateness of each order based on ACR. The principal investigator and coinvestigator radiologist assessed agreement between the clinical diagnosis and MRI/surgical findings.

**RESULTS:** Knee (31%) and shoulder (25%) injuries were the most common. Overall, 55% of injuries were acute. The mean ACR rating was 7.7 and the percentage of orders complying with ACR appropriateness criteria was 83.2%. Physical therapist's clinical diagnosis agreed with the MRI/MRA findings in 64.8% of cases and agreed with surgical findings in 90% of cases.

**CONCLUSIONS:** Physical therapists providing musculoskeletal primary care in a direct-access sports physical therapy clinic appropriately ordered advanced diagnostic imaging in over 80% of cases. Future research should prospectively compare physical therapist appropriateness and utilization to other groups of providers and explore the effects of physical therapist imaging privileging on outcomes.

**CLINICAL RELEVANCE:** Physical therapists appear to appropriately order advanced diagnostic imaging at rates that do not exceed other published data.

**OP055**

**CONFIDENCE OF PHYSICAL THERAPISTS’ DIAGNOSTIC CLINICAL DECISION MAKING USING SPECIAL TESTS DURING A SHOULDER EVALUATION:**

**A QUALITATIVE STUDY**

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**PURPOSE/HYPOTHESIS:** Recent literature indicates poor diagnostic accuracy for shoulder special tests during an evaluation. There is minimal evidence to determine if a change in diagnostic accuracy is influenced by the use of special tests. This study attempts to add to the current literature. Opinions vary on the importance of clinical special tests within a shoulder evaluation. The purpose of this study was to determine whether confidence in diagnostic hypotheses using shoulder special tests is dependent on the years of experience and expertise.

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

**MATERIALS/METHODS:** One hundred fifteen physical therapists responded to an online survey distributed through the Orthopaedic Section of the American Physical Therapy Association (APTA), in addition it was posted to several social media platforms followed by orthopaedic physical therapists. Survey respondents consisted of Doctors of Physical Therapy (DPT) students on orthopaedic internships, physical therapists of less than 1 year, 1 to 5 years, 5 to 10 years, and over 10 years of experience. Survey was completed by 95 out of the 115 respondents, consisting of 46 females and 49 males, with a mean ± SD age of 32 ± 9.2 years. A 13-question survey included demographic questions related to number of years of experience, and postgraduate clinical experiences or education. Questions regarding confidence of diagnostic hypothesis during a shoulder evaluation were reported on a Likert scale 0 (not confident at all) to 5 (very confident). Clinicians’ primary influence during an evaluation for diagnostic hypothesis was explored based upon years of experience and expertise. Data were analyzed using IBM SPSS Statistics to determine if relationships exist between reported years of experience, postprofessional education and rated confidence levels following special tests.

**RESULTS:** No significant differences or correlations were found between years of experience and confidence levels following the performance of an orthopaedic shoulder evaluation. Significant differences (P<.05) were found between groups with and without specialty certifications while performing the subjective portion of the evaluation; however, there were no significant changes in confidence based upon objective and special test outcomes. Physical therapists with postprofessional education showed no significant differences between confidence levels following special tests.

**CONCLUSIONS:** Results indicate that the level of confidence during an orthopaedic shoulder evaluation remain constant and was not dependent on years of experience or influenced by special tests. Less reliance on special tests was seen with increased years of experience.

**CLINICAL RELEVANCE:** The lack of significant changes in confidence between years of experience and expertise, demonstrates less reliance on special tests based upon responses. This study provides a foundational study for further investigation on clinicians’ confidence with special tests in the consideration of physical therapy education.

**OP056**

FRONTAL PLANE PROJECTION ANGLE AND ACCELERATIONS DURING THE SINGLE-LEG SQUAT WITH VISUAL PERTURBATION


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**PURPOSE/HYPOTHESIS:** Faulty movement patterns provide the therapist with information on the patient’s diagnosis and visual feedback to the patient during such tasks is improves performance. The single-leg squat (SLS) is one such functional test and the purpose of this study was to compare frontal plane projection angles (FPPA) and accelerometer data in the SLS with normal vision and with visual perturbation in healthy individuals to establish normative data. We hypothesized to see differences between the conditions and that visual perturbation would increase movement variability but not necessarily FPPA.

**NUMBER OF SUBJECTS:** Thirty-eight healthy subjects (22 female, 16 male) that were 24.7 ± 3.3 years old and weighed 74.1 ± 16 kg.

**MATERIALS/METHODS:** In a counter-balanced, repeated-measures design, subjects performed squats in 2 visual conditions: Normal vision and then while wearing visual perturbation strobe-glasses set at 30 Hz (OpsurS USA, West Milford, NJ). The squatting technique was performed in 2 conditions, single leg and also double-legged, which served as a control condition. Both squatting conditions required the subject to squat to 60° of knee flexion using a predetermined seat target for consistency while moving at an externally-paced metronome recording set to 30°/s. The SLS required subjects to squat with the dominant leg. A smartphone was attached to the subjects’ distal thigh, and data were exported using the Sensor Kinetics Pro accelerometer application that recorded data at 30 Hz. Raw accelerometer data were filtered and a composite index was computed for all 3 axes, and z-axis (mediolateral) data were also extracted for comparison. For the z-axis data, a coefficient of variation (COV) was computed. The FPPA was calculated at the knee position of 60° with the 2-dimensional HUDL technique video analysis application recording at 30 Hz. Accelerometer data were subsequently compared with a condition by vision repeated measures ANOVA and post hoc paired t tests corrected for alpha inflation with the Bonferroni procedure using SPSS software (Version 22.0; IBM, Armonk, NY).

**RESULTS:** The FPPA grand mean was 174.5° ± 2°, and was not different between conditions (P>.05). For the composite axes data, we found significant main effects for vision (P<.001), and also the interaction of vision and condition. For the interaction, paired t tests showed a significant difference (P = .04) between the SLS stroboscopic condition (9.86° ± 0.07°) compared to the SLS with normal vision (9.85° ± 0.6°). The SLS strobed condition (0.82° ± 0.3°) also had a higher COV (P<.001) with the z-axis (mediolateral) data compared to SLS with normal vision (0.75° ± 0.3°).

**CONCLUSIONS:** This data show that despite a small FPPA angle of approximately 5°, accelerometer data revealed that subjects performed differently in the various conditions, but particularly in the SLS with visual perturbation.

**CLINICAL RELEVANCE:** The oscillations detected by the smartphone accelerometer provide objective information about movement quality during the SLS that are not associated with a large FPPA.
THE EFFECT OF GAIT CADENCE MODIFICATIONS ON KNEE JOINT LOAD DURING WALKING

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PURPOSE/HYPOTHESIS: The purpose of this study was to examine how cadence modifications at a fixed self-selected walking speed influence KAM and KFM during gait.

RESULTS: Number of subjects: 24 knees across 12 individuals. Mean ± SD peak KAM was 2.004% ± 0.742% body weight-height per second in the control condition, 2.719% ± 0.590% in +10% cadence, 2.096% ± 0.729% in –10% cadence, 2.149% ± 0.673% in +10% and 10% decrease in cadence (–10%) at the same self-selected speed. KFM and KAM were measured using the instrumented split-belt treadmill (R-Mill, Force Link, the Netherlands) and 10-camera motion capture system (Qualisys, Sweden). After baseline control treadmill walking, participants were given 10 minutes to adapt to the altered cadence for the randomized conditions. Gait kinematics and kinetics were processed and computed using the Visual3D software (C-Motion, USA). A repeated-measures analysis of variance (ANOVA) was used to compare the 3 conditions and Bonferroni post hoc tests for pairwise comparisons, with the peak KAM and KFM as dependent variables and the varying cadences as independent variables.

RESULTS: Mean ± SD peak KAM was 2.004% ± 0.742% body weight-height in the control condition, 2.096% ± 0.742% in +10% cadence, and 2.091% ± 0.649% in –10% cadence. Mean ± SD peak KFM was 4.252% ± 0.729% body weight-height in the control condition, 3.800% ± 2.111% and 4.808% ± 1.486% in +10% and –10% cadence, respectively. KAM did not differ among 3 conditions (P = .01). KFM differed among 3 conditions (F(2,30) = 2.00, P < .05); +10% cadence resulted in 11% lower KFM and –10% cadence had the opposite effect of 13% greater KFM.

CONCLUSIONS: Walking with a faster cadence significantly reduced peak KFM. Similar to the observations in runners, these results suggest that increasing cadence is an effective strategy at reducing KFM, thereby reducing PF compressive forces during gait.

CLINICAL RELEVANCE: The findings of this study support a simple and effective approach to significantly reduce PF knee load, which may in turn relieve pain during walking. This creates a possible adjunct to therapy for patients with PF pain or knee OA, as it may decrease load and pain during daily ambulation. Further investigation is needed to examine the longer-term effect of this intervention on KAM, KFM, and subjective reports of pain in patients with PF pain and/or knee OA.

THE EFFECTS OF MYOFASCIAL RELEASE ON THE LATENCY OF DELAYED-ONSET MUSCLE SORENESS

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PURPOSE/HYPOTHESIS: The purpose of this study was to determine the effectiveness of a manual myofascial release technique (MFRT) in reducing the symptoms of delayed-onset muscle soreness (DOMS) in recreational athletes. Previous research has shown that many proposed treatments for DOMS are not effective at reducing eccentric-induced muscle soreness. One of the most effective interventions has been shown to be manual massage. It is unclear if manual myofascial release is effective in reducing pressure pain threshold and perceived pain associated with DOMS.

NUMBER OF SUBJECTS: Thirty recreational athletes were recruited to participate in the investigation; however, 10 subjects did not develop sufficient DOMS (operationally defined as greater than 20% decrease in pressure pain threshold 48 hours postexercise) and were excluded from the study. Thus, 20 adult athletes (16 women, 4 men) participated in this investigation. Mean ± SD for age was 24 ± 1.2 years.

MATERIALS/METHODS: Before the initiation of the eccentric protocol to create DOMS, baseline perceived pain level and pressure pain threshold (PPT) were assessed using the visual analog scale (VAS) and pressure algometry, respectively. The PPT measurement sites were standardized according to anatomic landmarks on the right thigh. Participants completed the DOMS protocol, consisting of 5 sets of 25 eccentric quadriceps contractions on a Cybex dynamometer. Forty-eight hours after the protocol completion, pretreatment measurements were taken to establish the baseline level of DOMS. Participants were randomly assigned to the treatment or control group. The treatment group received the manual MFR technique on the lateral side of the right thigh between the greater trochanter and lateral epicondyle of the femur. Pressure pain threshold and VAS measurements were collected at 5 minutes, 20 minutes, and 24 hours posttreatment. Data were analyzed using a repeated measures ANOVA.

RESULTS: There was not a significant interaction effect between group and time for PPT (P = .16) or VAS (P = .45). There was a significant main effect for group for PPT (P < .05) but there was for VAS (P < .01). There was a significant main effect for time for both PPT (P < .003) and VAS (P < .002).

CONCLUSIONS: Based on the results of this investigation, there is inconclusive evidence to support the use of myofascial release technique to reduce pressure pain threshold in subjects with eccentric-induced delayed onset muscle soreness. This study supports long-standing evidence that time is perhaps the most effective treatment for reducing the symptoms of delayed onset muscle soreness. Further research with a larger sample size and a higher dose of the treatment technique is warranted.

CLINICAL RELEVANCE: Healthcare providers, coaches, and athletes have long sought to identify effective interventions to reduce and speed the recovery of eccentric-induced delayed onset muscle soreness. There is insufficient evidence at this time to support myofascial release techniques as an effective treatment.
ducible pain, and improve function in individuals with NALBP.

**NUMBER OF SUBJECTS:** Twenty-four healthy adults (7 male, 17 female) participated in this investigation. Mean ± SD for age was 21.0 ± 1.6 years.

**MATERIALS/METHODS:** Participants were randomized to the treatment or control group (n = 12 experimental, n = 12 control). The treatment group participated in a 4-week (30 minutes, 2 times per week) pragmatic sensorimotor training program that included kinesthetic and graphesthesia training, traditional motor control/strengthening exercises, and novel diaphragm/respiratory training with aSpiroTiger (SpiroTigerMedical) device. The control group received a 5-minute educational session that focused on the anatomy and biomechanics of the lumbar spine. Limits of stability measures (reaction time, movement velocity, directional control, and maximal excursion) were assessed using the Balance Master Version 7.0.9 at baseline and at 5 weeks.

**RESULTS:** Independent pooled t tests revealed no statistical differences between the treatment and the control groups for any of the tested variables; however, several variables approached the alpha level of .05. The P value for reaction time in the forward direction was .06, and a post hoc power analysis revealing that n = 27 subjects would be needed to have a power of 0.80 with a raw effect size of 0.53 seconds.

**CONCLUSIONS:** This proof of concept investigation did not reveal a statistical difference between groups in healthy subjects over a 4-week training program. It is hypothesized that the effect sizes will be larger in individuals with NALBP that have altered sensorimotor function. The training protocol was designed for individuals with NALBP; thus, it is believed that the treatment dose was insufficient for healthy individuals. When translated to individuals with NALBP, the treatment duration will be extended to 8 weeks.

**CLINICAL RELEVANCE:** As movement system specialists, physical therapists need to better understand how individuals with LBP move and respond to targeted training programs to help prevent chronicization and recurrence of LBP. While the results of this study cannot be translated into clinical practice, valuable information was obtained to help design an RCT for individuals with NALBP.

**OPO60**

**SPINAL IMAGING IN PATIENTS WITH SYMPTOMATIC LOW BACK PAIN: A SYSTEMATIC LITERATURE REVIEW**

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**PURPOSE/HYPOTHESIS:** Rates of advanced imaging in the lumbar spine continue to rise despite a growing body of literature indicating its limited value for individuals with low back pain (LBP). Some studies have even shown an increased risk of poor outcomes with overutilization of imaging. Systematic reviews have pooled data on abnormal findings in asymptomatic individuals with low back pain, however, no reviews to date have included only symptomatic low back pain patients. Therefore, the purpose of this review was to identify the rate of patients with abnormal findings to those without in a population specifically with symptomatic low back pain.

**NUMBER OF SUBJECTS:** Four thousand three hundred eighty-four total subjects with low back pain.

**MATERIALS/METHODS:** An online search was conducted on PUBMed for studies published through May 2016. Search strategy included keywords such as “low back pain,” “spine pain,” and “imaging,” “radiographs” or “MRI,” and “asymptomatic,” “irrelevant,” and “incidental.” Studies were included if authors reported the specific number of unique patients with or without back pain, and excluded if they included only asymptomatic subjects. Only patients with low back pain were extracted from studies that included both symptomatic and asymptomatic patients for the final count.

**RESULTS:** Out of 1389 potential studies, 11 were included in the final assessment, representing a total of 4384 subjects. Ages ranged from 14 to 86, with a median age of 46. Of these, 1824 (41.6%) unique patients with low back pain had an abnormal finding on imaging, while the majority 2560 (58.4%) had normal imaging reports. Large heterogeneity with reporting methods, such as reporting number of findings versus unique individuals, limits the studies from which counts of unique individuals can be extracted. In the studies analyzed, the majority of patients that sought medical care for low back pain had normal findings. Most studies with longitudinal data related to pain and disability, showed no significant association between changes in imaging abnormalities and changes in symptoms. The exception was in Modic endplate changes, which showed a greater association, at specific levels, with symptoms in some subsets of patients with low back pain.

**CONCLUSIONS:** While spine abnormalities on imaging are common in asymptomatic individuals; this review found that they are also common in symptomatic patients with low back pain. However, there were higher rates of normal findings in symptomatic individuals compared to abnormal findings.

**CLINICAL RELEVANCE:** It may be more likely that patients seeking medical care for low back pain have normal imaging findings than abnormal findings. Patients may still have high levels of pain and disability, and clinicians may need to focus on other education strategies that help explain pain and the cause of symptoms to the majority of patients seeking care for low back pain.
solute muscle thickness when comparing resting values to 120° of scaption ($P < .001$). There was a significant relationship between percent MVC EMG activity and the percent change in muscle thickness ($P = .01, r^2 = 0.26$).

CONCLUSIONS: There is a moderate positive relationship between SA EMG activity and percent change in muscle thickness as measured by UI. However, more research is needed with a pathological population to validate the use of UI in measuring SA muscle performance.

CLINICAL RELEVANCE: UI has the potential to be used on the SA as a means of assessment or biofeedback in a clinical setting.

OP063
MANUAL THERAPY FOR NONCARDIAC-RELATED CHEST WALL PAIN: A CASE REPORT
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BACKGROUND AND PURPOSE: Chest wall pain is one of the most common reasons individuals seek medical attention in the world. Because of the nature of the symptoms and the possible resemblance of signs and symptoms of a heart attack, chest wall pain accounts for 7.16 million visits to the emergency room annually in the United States. Only about one third are diagnosed with acute coronary symptoms and the remaining with noncardiac chest pain. Patients with noncardiac chest pain continue to experience chest pain for 1 to 11 years after the initial episode and almost half of noncardiac chest pain patients still believe they have a cardiac condition up to 1 year after negative cardiac evaluations. About 30% of noncardiac chest pain patients are diagnosed with costochondritis. No systematic reviews or clinical trials regarding optimal treatment for costochondritis have been identified. The purpose of this case report is to describe the successful treatment of a patient diagnosed with costochondritis and the important role physical therapy plays in easing anxiety over chest wall pain.

CASE DESCRIPTION: A 29-year-old man presented with left sided anterior chest wall pain that began insidiously about 1 year prior. His pain was described as a strong ache, rated 6/10 on the numeric pain rating scale. He went to the emergency room on 2 separate occasions due his symptoms and the fear of a heart attack, with negative findings. Significant past medical history included anxiety. Examination revealed: pain with left shoulder combined flexion, adduction and external rotation with overpressure, seated AROM thoracic left rotation with overpressure and with palpation of the left fourth to sixth costosternal joint, pain and hypomobility of the upper thoracic spine and a positive left upper limb neural provocation test with median nerve bias. Interventions included anterior to posterior mobilization at the left fourth to sixth costosternal joint, posterior to anterior mobilization to the upper thoracic spine (T2-T7), pectoral stretching for home and assurance that his chest wall pain was musculoskeletal.

OUTCOMES: Three physical therapy appointments resulted in improvements in: pain 0/10 at the worst, pain-free AROM thoracic rotation, negative neural provocation testing, Neck Disability Index score; 0/100, and decreased anxiety.

DISCUSSION: Costochondritis is a common cause of noncardiac chest pain. This case report details the successful treatment of a 29-year-old man with a diagnosis of costochondritis who reported to the emergency department on 2 separate occasions due to the nature of his chest pain. Physical therapy assessment clearly reproduced the patient’s pain, which had not occurred in previous medical visits. Earlier multimodal therapy intervention could have saved unnecessary visits to the emergency department and improved his quality of life soon.

**OP064**

**DOES THE DIRECTION OF ELASTIC TAPE APPLICATION INFLUENCE JUMPING ABILITY IN ASYMMETRIC INDIVIDUALS?**

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**PURPOSE/HYPOTHESIS:** Elastic tape is commonly used for athletic performance enhancement. One of the proposed mechanisms for the effects of elastic tape is changes in local muscle contractions. This study examined the short term effects of the direction of elastic tape application to the quadriceps muscle on 3 jumping tasks.

**NUMBER OF SUBJECTS:** Fifteen.

**MATERIALS/METHODS:** Fifteen healthy subjects (9 female, 6 male), with a mean age of 23 years, participated in this pilot study. Using a crossover design, subjects were tested over 2 sessions with a one-week washout period between sessions. All subjects were naive to the use of elastic tape. Each session began with a 5-minute warm-up followed by baseline triple hop and vertical jump testing. Following baseline testing, tape with a “Y” cut was applied with 25% tension to the quadriceps muscle on the dominant leg in a distal-to-proximal or proximal-to-distal direction, and subjects were re-tested. Triple hop distance with the dominant leg and vertical jump height were measured over 3 trials. The mean and maximum scores of the 3 trials were computed for each participant under each taping condition. One week later, subjects repeated all testing with tape applied in the direction opposite to their initial testing. The direction of tape application was randomized and subjects, testers and the data analyst were blinded to the direction of tape application.

**RESULTS:** Means triple hop distance increased by 13.6 cm when taped proximal to distal, and decreased by 0.7 cm when taped distal to proximal (P = .046). Maximum triple hop distance increased by 9.4 cm when taped proximal to distal, and decreased by 3.8 cm when taped distal to proximal (P = .33). There were no significant baseline-taped differences in vertical jump scores according to taping condition.

**CONCLUSIONS:** The results of this study suggest that the application of elastic tape may have an impact on hopping distance but not on jumping height. The direction of tape application was associated with hopping distance. This is a pilot study and may not be powered by enough subjects to detect a minimal difference. These findings are interesting however and may be worth exploring in further studies.

**CLINICAL RELEVANCE:** The effects seen in this study were small and limited to 1 of the functional tests. As a result, clinicians should remain skeptical of the claim that the application of elastic tape has an impact on lower extremity functional performance.

**OP065**

**THE USE OF DROPOUT CASTING IN A PATIENT WITH PERSISTENT KNEE FLEXION CONTRACTURE POST–ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION**

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**BACKGROUND AND PURPOSE:** Research has shown that loss of extension following anterior cruciate ligament reconstruction (ACLR) may be related to limited preoperative extension and effusion [2]. Other factors that may also impact knee extension include concomitant injury and postoperative stiffness [4]. However, treatment of those who have a loss of extension has been limited in the research community, with very little evidence available on the use of dropout casting [1,3]. The purpose of this case study is to demonstrate the effectiveness of drop-out casting in a patient with a loss of knee extension following ACLR.

**CASE DESCRIPTION:** Patient is a 45-year-old woman who was initially seen preoperatively for L ACL tear, grade 2 MCL tear and medial meniscus tear. After failure to improve in her range of motion (ROM), she underwent surgical intervention with a knee flexion contracture (albeit not recommended), including manipulation under anesthesia, ACLR with allograft, a partial meniscectomy, and synovectomy. At initial postoperative evaluation, impairments on the involved side included lacking 1° of knee extension to 55° of knee flexion, 28% quadriceps MVC, and KOS ADL score of 20%. Although patient did make gains in knee ROM, quadriceps strength, and function over the initial postoperative 8 week period, her knee extension ROM began to regress (up to lacking 9°). After no resolution of flexion contracture for 2 weeks, a dropout cast was utilized for a total of 6 weeks to provide low-load long duration (LLLD) stretching to assist in improving knee extension ROM while physical therapy continued to emphasize quadriceps strengthening and improved functional use of knee extension. Provided treatment included quadriceps strengthening, NMES, gait training, and manual therapy. After she consistently presented with full knee extension between and during visits for 2 weeks, the cast was gradually weaned from use.

**OUTCOMES:** Postoperatively, the patient was seen for a total of 50 visits over 24 weeks. At the first visit following initiation of the dropout casting, patient demonstrated a 6° improvement in knee extension ROM that maintained for 8 visits over 2 weeks. The cast was remade after the LLLD stretching was no longer increasing range due to loosening at that time. Following a second casting intervention for an additional 8 visits over a 2-week period, patient demonstrated further improvement in ROM (3°-4°) that remained until discharge. From baseline to discharge, the patient made a 7° improvement (lacking 2°) in knee extension ROM overall. KOS ADL scores also made a clinically significant improvement to 79% following the implementation of the dropout cast while quadriceps strength also improved to 114% MVC [5].

**DISCUSSION:** This case study demonstrates the effectiveness of dropout casting in a patient with loss of knee extension following ACLR. However, additional research should be completed to determine the best parameters for usage and number of casts needed per person.


**OP066**

**THE USE OF A MODIFIED TENDON-LOADING PROGRAM IN A PATIENT WITH COMPLEX UNILATERAL ACHILLES TENDON REPAIR**

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**BACKGROUND AND PURPOSE:** Acute Achilles tendon rupture is commonly treated via surgical repair. However, a serious complication to surgery is infection, with superficial wound infection occurring in 4% to 20% and deep wound infection in 1% to 2% of patients [1,4]. The most optimal treatment following postoperative wound infection is undescribed [4]. This case study describes the use of a comprehensive rehabilitation program including gradual tendon loading on a patient post–Achilles tendon repair complicated by deep wound infection.

**CASE DESCRIPTION:** This case is a 65-year-old man 6 months post–Achilles
tendon repair, followed by multiple debridements and wound vacuum (VAC) closure. The most recent debridement was 3 months prior to initiation of physical therapy (PT). Diagnostic ultrasound imaging revealed an in-tact, hypoechoic tendon repair with osteomyelitis on the ruptured side and tendinosis on the nonruptured side. Upon initial evaluation, the patient presented with weakness of the ankle musculature with an inability to perform a unilateral heel-rise. Limb symmetry indexes (LSI = (affected/unaffected) x 100%) showed 66% inversion, 78% eversion, and 79% dorsiflexion asymmetry [6]. Functionally, the patient reported moderate to severe disability evidenced by Victorian Institute of Sports Assessment-Achilles Questionnaire (VISA-A) score of 50/100 on nonrupture side, Achilles Tendon Total Rupture Score (ATRS) of 31/100 on ruptured side, and Patient Specific Functional Scale (PSFS) average of 4/10 points [2,3,5]. The patient was seen by PT for 24 visits over 4 months. Rehabilitation emphasized gradual tendon loading, using a slow progression of heel rises following the pain-monitoring model. Balance activities, gait retraining, and functional/neuromuscular electrical stimulation were also included in the patient’s plan of care.

OUTCOMES: Midway through the patient’s PT course, ankle, inversion, eversion, and dorsiflexion LSI improved to 94%, 99%, and 104%, respectively. At discharge, the patient had a VISA-A score of 89/100, ATRS score of 57/100, and PSFS average score of 7/10. The patient was also able to complete the heel-rise test, performing 189 J total work, 7 repetitions, and maximum heel-rise height of 4 cm on ruptured and 906 J, 26 repetitions, and 6.7 cm maximum heel-rise height on nonruptured sides.

DISCUSSION: A multimodal PT plan of care, incorporating gradual tendon loading yielded positive functional outcomes, evidenced by improved clinical and patient self-reported outcomes, in an individual following Achilles tendon repair with a complex healing course.

OP069
MOVEMENT AND SUSTAINED FUNCTIONAL ACTIVITY NECK PAIN RATINGS: A USEFUL ADDITION TO MEASURE IMPROVEMENT?
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PURPOSE/HYPOTHESIS: Neck pain is a common disorder managed by physical therapists. However, there is a need for additional intermediate measures of clinical improvement in disability for clinicians to monitor progress. Range of motion and motor control are weakly associated with disability, and resting pain is only moderately related to disability. Measures of movement-related pain account for unique variance in self-reported disability, beyond the variance accounted for by a traditional measure of neck pain suggesting these additional specific pain-related metrics may be more sensitive to track clinical improvement. Therefore, the purpose of this study was to investigate whether fluctuations in pain related to movement and sustained positions account for unique fluctuations in self-reported disability not accounted for by traditional measures of pain intensity.

NUMBER OF SUBJECTS: Eighty-seven people with moderate (approximately 5/10) chronic mechanical neck pain (mean ± SD age, 56 ± 8 years; 85% female; NDI, 13 ± 6) completed 18 weeks of self-reported disability, intensity of neck pain, pain with movement, and pain with sustained activities.

MATERIALS/METHODS: Secondary analysis of data collected for a therapeutic exercise intervention study. Disability was assessed with the neck disability index (NDI). Spontaneous pain intensity, pain with movement (personal care, lifting, overhead activities, meal prep, housework) and sustained activities (driving, reading, computer use, sleeping, work, sitting, standing) were assessed using 11-point numeric rating scales. Multilevel modeling for change was used to address within-person and between-person questions about changes in NDI simultaneously. NDI was the dependent variable in all models with neck pain intensity, age, and treatment group included as baseline model predictors. Subsequent models included the same predictors and added measures of movement-evoked pain. A final parsimonious model was constructed with significant (P<.05) pain characteristic predictors.

RESULTS: The baseline model explained 39% of the variance in NDI. The final parsimonious model (-2LL = 3964, AIC = 3974, BIC = 3998) explained 47% of the variance in NDI and showed a significant improvement in model fit statistics (χ² = 350, df = 2, P<.01) compared to the baseline model.

CONCLUSIONS: The final model showed that fluctuations in disability covaried with the intensity of spontaneous pain and pain with sustained activities while the intensity of movement-evoked neck pain explained individual differences in the trajectory of disability improvement. These results suggest that pain related to movement and sustained activities represent disability-relevant dimensions of neck pain not captured by traditional measures of spontaneous pain.

CLINICAL RELEVANCE: Movement and sustained activity-related pain ratings are a useful, fast and simple, additional measure for clinicians to assess. Fluctuations in activity-specific pain help explain variations in patient disability over time and distinguish between patients and may be useful for clinicians to assess additional changes.

OP070
EPIDEMIOLOGY OF HIP FLEXOR AND ADDUCTOR STRAINS IN NATIONAL COLLEGIATE ATHLETIC ASSOCIATION ATHLETES, 2009-10/2014/15
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PURPOSE/HYPOTHESIS: The purpose of this study was to describe the epidemiology of hip flexor and adductor strains across 25 NCAA championship
Evaluating the effectiveness of prevention programs is not possible without accurate baseline data. The majority of hip flexor (62.4%) and adductor strains (65.7%); 11.1% of hip flexor strains versus 0.97/10,000 AE; IRR = 1.56; 95% CI: 1.28, 1.90), with no difference versus 0.85/10,000 AE; IRR = 1.63; 95% CI: 1.33, 2.00); (hip adductor 1.86 versus 1.13/10,000 AE; IRR = 1.65; 95% CI: 1.38, 1.97). Among sex-comparable sports, the hip flexor strain rate was higher in men than women (1.51 versus 0.97/10,000 AE; IRR = 1.18; 95% CI: 0.93, 1.49). Noncontact was the mechanism for most hip flexor (62.4%) and adductor strains (65.7%); 11.1% of hip flexor strains, and 11.4% of adductor strains, were recurrent. 80.0% of hip flexor strains and 82.3% of adductor strains resulted in less than 1 week of participation restriction, and over 50% of each were NTL. No differences were found between sex-comparable sports in mechanism, recurrence, or participation restriction.

CONCLUSIONS: The majority of hip flexor and adductor strains occurred in practice, were due to noncontact, and resulted in less than 1 week participation restriction. In sex-comparable sports, men experienced a higher rate of hip flexor, but not adductor, strains than women, and no differences were found in mechanism, recurrence, or participation restriction.

CLINICAL RELEVANCE: This study provides a baseline from which to develop improved recommendations for the prevention and rehabilitation of hip flexor and adductor strains that are both sport- and mechanism-specific. Evaluating the effectiveness of prevention programs is not possible without accurate baseline data.

OP072
DIFFERENCES BETWEEN DYNAMIC FUNCTIONAL TESTING AND PRESSURE PAIN THRESHOLD VALUES IN FEMALE DISTANCE RUNNERS WITH AND WITHOUT A PRIOR INJURY HISTORY
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PURPOSE/HYPOTHESIS: A prior injury history and being female has been shown to be associated with an increased risk for sustaining a running-related injury (RRI). These overuse injuries can frequently recur or become chronic. Muscle weakness, temporal parameters, and altered biomechanics have been described as potential contributors to RRIs. Recently theorized, individuals with greater localized hyperalgesia from chronic lower extremity conditions may also exhibit altered lower extremity mechanics from increased nociceptive input. The purpose of this pilot study was to investigate differences between dynamic functional testing and pressure pain threshold (PPT) values in female distance runners with and without a prior injury history.

NUMBER OF SUBJECTS: Sixteen female runners (mean ± SD age, 23 ± 3.4 years) were recruited from the local university community. Inclusion criteria consisted of running a minimum of 1.5 hours per week for at least 6 weeks prior to testing. Subjects had a mean ± SD body mass index of 24.02 ± 2.12 kg/m², and had reported running for a mean 7.11 ± 3.74 years at an average of 18.89 ± 9.40 mi/wk.

MATERIALS/METHODS: A running activity and injury questionnaire, Pain Catastrophizing Scale, and Lower Extremity Functional scale was completed by all subjects prior to testing. Functional performance testing was assessed via the Y Balance Test (YBT), and PPT was quantified at 6 different lower extremity sites bilaterally with a digital pressure algometer.

RESULTS: Of the 16 subjects, 8 had reported a prior history of lower extremity injuries and 8 had not. There were no differences between dynamic functional testing and pressure pain threshold (PPT) values in female distance runners with and without a prior injury history.
tremity injury requiring time off from running and medical treatment. No significant differences were found between prior injury history and running pace, running volume, or years running. There was a significant difference for runners with an injury history to have a greater than 4 cm side to side difference on the YBT (P = .009), in addition to a significant difference for YBT absolute difference between extremities (P = .030). For PPT, no significant difference in mean threshold values between groups was found. There was a fair to moderate correlation (ICC range, 0.46-0.62) between YBT composite score and PPT at both the distalibia and patella retinaculum in this group of runners.

CONCLUSIONS: Female runners with a prior history of lower extremity injury exhibited greater asymmetry with dynamic functional testing compared to the uninjured group. While no significant differences were found between groups for PPT values in the lower extremity, there was a fair to moderate association between YBT scores and PPT of the distalibia and patella retinaculum. Further investigations should expand on the relationship between lower extremity functional performance and running mechanics on PPT.

CLINICAL RELEVANCE: Female distance runners with a prior history of a RRI may exhibit continued deficits in dynamic functional testing. The relationship between nociceptive changes and functional performance in should be considered in the management of those runners with a prior injury history.

ANODAL TRANSCRANIAL DIRECT-CURRENT STIMULATION RESULTS IN INCREASED MAXIMUM ISOMETRIC TRUNK EXTENSOR STRENGTH IN HEALTHY SUBJECTS

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PURPOSE/HYPOTHESIS: Direct medical costs for low back pain exceed $90 billion per year in the United States, driven primarily by 10% of patients who develop chronic low back pain (cLBP). Existing treatments for cLBP pain have proven to be of limited benefit to reduce disability and improve function. The purpose of this study was to investigate the effects of anodal transcranial direct current stimulation (tDCS) on trunk extensor strength. Anodal tDCS treatment has been shown to increase strength in arm muscles, but its effects on isometric trunk extensor strength are unknown. Accordingly, trunk extensor strength was tested during 20 minutes of tDCS treatment and for 40 minutes after treatment in both healthy control (HC) and cLBP subjects.

NUMBER OF SUBJECTS: Seventeen subjects (8 HC and 9 cLBP) aged 20 to 44 years.

MATERIALS/METHODS: Subjects attended 2 sessions. Baseline maximum isometric trunk extensor force was tested using a MedX core trunk extension device custom fitted with a single DOF load cell (Load Cell Central). Subjects were seated with a neutral spine position, 90° of hip flexion, and 60° of knee flexion, and were instructed to push back into the backrest. Subjects received visual feedback displaying their max force and current force on a computer screen and verbal encouragement was provided using a digital recording to ensure uniformity. Subjects then received a 20-minute treatment of either sham or anodal tDCS (subjects and researchers were blinded to treatment order) at 2-mA intensity with a 30 second ramp up and ramp down. During sham tDCS, subjects received only the ramp up and ramp down. The 2 × 2-inch stimulating electrode was positioned on a saline soaked sponge over the central sulcus of M1; the cathode was placed on the right side of the forehead. Every 10 minutes during the session, participants performed a maximum isometric trunk extension.

RESULTS: The cLBP group generated lower peak isometric extension force compared to HC (P<.05). There was a main effect of treatment (anodal, sham) on peak isometric extensor force (P = .014) and a trend for an interaction of group (cLBP, HC) by treatment (P = .062). Follow up analyses revealed a single treatment of anodal tDCS increased trunk extensor force compared to sham only for HC (P<.001). Although statistically insignificant, trunk extensor force was larger during anodal tDCS compared to sham in the cLBP group.

CONCLUSIONS: These preliminary results indicate that anodal tDCS placed over the central sulcus for 20 minutes can result in increased back extensor strength up to 40 minutes posttreatment in HC, which may have potential use as an adjunct to trunk extension exercises in order to maximize force generation.

CLINICAL RELEVANCE: This study has revealed the potential for anodal tDCS to be used to increase motor function resulting in increased trunk extensor force in healthy individuals. The next step in this research will be to determine how anodal tDCS can be used to improve motor function and ultimately reduce disability in a larger population of people with cLBP.

MUSCLE QUALITY MATTERS: TRANSLATION OF MUSCLE FAT INFILTRATION ANALYSIS TO CLINICAL PRACTICE AND BIOMECHANICAL MODELING

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PURPOSE/HYPOTHESIS: Increased muscle fat infiltration (MFI) is related to poor functional recovery following whiplash. However, the complexity and time constraints of a quantitative analysis of MRI images may hinder translation into radiology clinical practice and interdisciplinary research. We employed a qualitative metric for magnitude and distribution of MFI in the cervical multifidus muscle using fat/water MRI. We assessed the ability of this method to predict clinical presentation. Additionally, we demonstrate the value of the resulting muscle quality data to explore the functional consequences of muscle degeneration in a biomechanical model of the neck.

NUMBER OF SUBJECTS: Thirty-one subjects (14 male, 17 female; mean ± SD age, 41.5 ± 10.6 years; range, 22-61 years) and 31 age- and sex-matched healthy controls were recruited from a randomized controlled trial at baseline. Inclusion criteria included neck disability index (NDI) of greater than 20% at 3 months to 3 years postcollision. Three study groups were controls, mild/moderate WAD (NDI greater than 20%, less than 40%), and severe WAD (NDI greater than 40%). The local ethics committee approved the study, and written informed consent was obtained from all participants.

MATERIALS/METHODS: Phase sensitive reconstruction of the data were performed and the multifidus was identified and segmented by a blinded operator in the fat/water images (C4-C7), using Analyze 11.0 (AnalyzeDirect, USA). The multifidus muscle was manually divided in 8 equally sized regions. MFI was visually graded according to: 0 for no or marginal MFI, 1 for light MFI, and 2 for distinct MFI. Statistical analysis was performed in SPSS 19 (IBM, 2010). Data characterizing the spatial distribution of MFI in the severe, mild/moderate, and control groups was used to specify muscle parameters in a computational neck model.

RESULTS: Twenty-one (68%) of the patients had mild to moderate disability and 10 (32%) had severe disability. Statistically significant differences in the overall frequency of a grade 2 were found between healthy controls and severe WAD (P = .03) and between mild/moderate and severe WAD (P = .03). The ROC analyses indicated fair (AUC = 0.768) discrimination between the severe versus mild/moderate WAD groups when considering frequency of distinct (grade 2) MFI.

CONCLUSIONS: The distribution of MFI agreed with previous work showing
greater fat along the medial and anterior regions of the multifidus muscle in all groups, with globally elevated MFI in the severe WAD group. Predictions from the biomechanical model highlight potential differences in muscle activation patterns and joint stresses due to the specific spatial distribution of MFI in severe WAD.

**CLINICAL RELEVANCE:** The complexity of methods for measuring quantitative MFI has been a barrier to translation into clinical practice and cross-disciplinary research (eg, biomechanics). With translation in mind, this study proposes a novel qualitative MR method for grading degeneration in needling. Psychological demonstrates an example of its use in a biomechanical modeling application.

**OP075**

**HEIGHTENED PAIN SENSITIVITY AND INEFFICIENT ENDOGENOUS PAIN MODULATION IN PATIENTS WITH OROFACIAL PAIN: A LONGITUDINAL STUDY**

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**PURPOSE/HYPOTHESIS:** We aimed to investigate if heightened pain sensitivity (1) is associated with inefficient endogenous pain modulation (2) using quantitative sensory testing (QST) [3,4,5] in patients with orofacial pain.

**NUMBER OF SUBJECTS:** Forty.

**MATERIALS/METHODS:** A convenience sample of subjects (n = 40) with orofacial pain seen for an initial visit at a specialized orofacial pain clinic were assessed for individual pain processing mechanisms using QST [3]. Pain sensitivity was assessed through Temporal Summation (TS) [3,4] while endogenous pain modulation through Conditioned Pain Modulation (CPM) [3,5] testing protocols. These procedures were administered prior to the subjects receiving any intervention, where baseline demographic, psychological variables, and self-reported disability scores were also collected. Psychological variables were measured using physical activity and work subscales of the Fear-Avoidance Beliefs Questionnaire (FABQ).

The numeric pain-rating scale was used for QST pain ratings and the Therapeutic Associates Outcomes Scale (TAOS) was used for self-reported disability measure. Pearson correlation analyses were conducted on TS and CPM scores, as well as self-reported psychological and disability measures.

**RESULTS:** A strong positive correlation was found between increased pain sensitivity and inefficient endogenous inhibitory pain modulation activity in patients with orofacial pain (r = 0.69, P = .001). A moderate negative correlation was also found between FABQ physical activity subscale and self-reported disability scores (r = -0.43, P = .0065); and FABQ work subscale and self-reported disability (r = -0.39, P = .012). Results of our study suggest that increased pain sensitivity is associated with marked deficiency in endogenous pain modulation system as measured through QST in patients who seek treatment for orofacial pain. It also appears that self-reported disability scores does not directly correlate with psychological factors on FABQ in these patients.

**CONCLUSIONS:** Our study was able to demonstrate a strong and direct correlation between heightened pain sensitivity and inefficient endogenous pain modulation in patients with orofacial pain. Furthermore, psychological factors did not appear to directly correlate with self-reported disability in this patient population.

**CLINICAL RELEVANCE:** Identification of factors that contribute to the cause and persistence of orofacial pain is an important research goal, as it is a preliminary step towards developing effective interventions in these individuals. Quantitative Sensory Testing provides direct and quantitative measure of individual pain processing mechanisms essential in understanding the etiology and associated impairments and limitations with orofacial pain. Future studies should support or refute these findings and investigate the nature of these associations to create effective intervention strategies in this patient population.

**OP076**

**SEX-SPECIFIC KINETIC AND KINEMATIC INDICATORS OF MEDIAL TIBIOFEMORAL FORCE DURING RUNNING**

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**PURPOSE/HYPOTHESIS:** Maintaining an active lifestyle while avoiding exertion is critical for individuals with medial tibiofemoral joint (TFJ) osteoarthritis (OA) [1]. During walking, lower medial TFJ force can be achieved by decreasing peak knee adduction moment (pKAM) and knee flexion moment (pKFM) [2,3]. However, the contribution of pKAM and pKFM to medial TFJ force during running is not known. Additionally, clinically modifiable kinematic variables to decrease peak medial TFJ force during running have yet to be identified. Differences in running mechanics between males and females raise the possibility that contributions to medial TFJ force are sex-specific [4]. Thus, the goals of this study were to (1) evaluate the sex-specific contribution of pKFM and pKAM to medial TFJ force during running; (2) identify sex-specific kinematic variables that can be measured in the clinic to estimate and modify peak medial TFJ loads.

**NUMBER OF SUBJECTS:** Eighty-seven healthy runners (36 female, 51 male; mean ± SD age, 23.0 ± 3.8 years).

**MATERIALS/METHODS:** Three-dimensional kinematic and kinetic data were collected during treadmill running at preferred speed (3.0 ± 0.4 m/s). Peak medial TFJ contact force was estimated using a validated musculoskeletal model [5]. Linear regression analyses were used to assess the contribution of kinetic (pKFM, pKAM) and kinematic variables to estimated peak medial TFJ force. Clinically modifiable kinematic variables of interest included sagittal and frontal knee, ankle and foot kinematics as well as step rate, step length, foot progression angle and center of mass (COM) vertical displacement.

**RESULTS:** In the whole cohort, the combination of pKAM and pKFM explained 64.5% of peak medial TFJ force variance during running (P < .001). Together, both variables accounted for 75.5% of peak medial TFJ force in females, and 73.8% in males (P < .001). However, pKAM contribution was only 26.8% in females compared to 50.4% in males. Analyses also revealed sex-specific kinematic predictors of peak medial TFJ force during running. In females, lower ankle dorsiflexion at foot strike and center of mass (COM) vertical displacement best predicted lower peak medial TFJ force (R² = 0.364, P = .012). In males, greater peak knee abduction angle and shorter step length best predicted lower medial compartment force (R² = 0.508, P = .019).

**CONCLUSIONS:** Our results suggest that pKAM and pKFM make significant but potentially sex-specific contributions to peak medial TFJ forces during running. Clinicians seeking reductions in peak medial TFJ force through running retraining interventions should aim for reduced ankle dorsiflexion at foot strike and COM vertical oscillation in females, and greater knee abduction and shorter step length in males.

**CLINICAL RELEVANCE:** These results provide insights on modifiable kinematic variables that can be addressed in the clinic to decrease medial TFJ force during running. Targeting identified predictors through running gait modifications may help physical therapists in treating their patient runners with symptomatic medial TFJ OA.

**OP077**

**FOR INDIVIDUALS WITH NONCONTACT ACL RUPTURE, IS THERE EVIDENCE OF HIP ROTATION RANGE-OF-MOTION LIMITATIONS? A LITERATURE REVIEW**

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**PURPOSE/HYPOTHESIS:** Anterior cruciate ligament (ACL) ruptures occur...
frequently and with high financial implications. It is estimated that 80% of ACL ruptures occur through a noncontact mechanism [1]. Studies have suggested that limited range of motion, specifically hip internal rotation, is a risk factor for noncontact ACL ruptures [2]. The purpose of this review is to determine whether there is evidence to support an association between hip rotation range of motion (ROM) limitations and noncontact ACL rupture.

**NUMBER OF SUBJECTS:** Not applicable.

**MATERIALS/METHODS:** Web of Science and PubMed were searched using the following search terms: ACL AND hip range; ACL risk AND hip range; ACL AND hip rotation; ACL AND hip; ACL risk factor. Studies were included if they examined healthy individuals, aged 13 to 65 years with noncontact ACL rupture. Additionally, studies using goniometric measures of hip rotation range of motion and those written in the English language were included. Studies were excluded if they examined participants with lower extremity pathologies other than ACL rupture, participants with contact ACL rupture, hip rotation range of motion measured during functional tasks or cadaveric studies.

**RESULTS:** Six articles met the inclusion criteria [2-7]. All studies were cross sectional by design, with male and female participants ranging from 13 to 40 years old. Studies included both athletes and nonathletes alike; however, a majority of the participants were male soccer players. Overall, participants with a limited sum of hip rotation range of motion had greater odds of having a history of ACL rupture compared to those without ACL rupture. Additionally, these studies suggested there was a statistically significant decrease in hip internal rotation range of motion among participants with ACL rupture compared to control participants. With the exception of 2 studies [2,3], there was no significant difference in hip external rotation range of motion differences between groups.

**CONCLUSIONS:** The results suggest that subjects with decreased hip rotation beyond a predetermined threshold, mainly due to internal rotation limitations, are at greater odds of having a history of ACL rupture. This is consistent with the theory that insufficient range of motion at the hip transfers rotational forces to the knee joint, thereby increasing stress on the ACL. Our review is limited in that the most at-risk population (eg, females and adolescents) are not represented.

**CLINICAL RELEVANCE:** Patients with a history of noncontact ACL rupture are at greater odds of presenting with limited hip rotation ROM, specifically in internal rotation. Clinicians should screen and consider hip rotation ROM when designing ACL prevention and rehabilitation programs.

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**OP079**

**INFLUENCE OF NEUROMUSCULAR CONTROL AND STRENGTH TRAINING OF CORE MUSCULATURE ON DISTAL FUNCTION: A SYSTEMATIC REVIEW**

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**PURPOSE/HYPOTHESIS:** The purpose of this review was to identify and differentiate the effects of neuromuscular and strength training of core musculature on distal function.

**NUMBER OF SUBJECTS:** Not applicable.

**MATERIALS/METHODS:** A comprehensive search was performed using PubMed, CINAHL, MEDLINE, and Google Scholar databases. Search terms included combinations such as: “Transversus Abdominis,” “TrA” AND “Activation,” and “TrA” AND “Strength.” This review targeted randomized controlled trials and cohort studies. Sackett (2000) ratings were used for initial inclusion assessing article eligibility. All remaining articles were then scored for internal validity by at least 2 reviewers using the MacDermid (2004) scoring (0-48 point scale). Discrepancies in scores were reviewed by all authors to achieve consensus for a final score.

**RESULTS:** Nine articles met our standards for inclusion in this review (level of evidence: 1 article; 1b; 8 articles, 2b). MacDermid scores ranged from 25 to 39, with a mean of 30. Interestingly, results of the review were equally split yielding 4 studies that proposed using neuromuscular training techniques, 4 supported strength training and 1 study supported both intervention strategies for augmenting various aspects of distal extremity function.

**CONCLUSIONS:** Based on the evidence, both neuromuscular and strength training of the transverse abdominis and surrounding core musculature have beneficial effects when they are included in treatments aimed at improving gait and upper and lower extremity function. However, the mechanism of application and time required to reach desired effects of each of these approaches is often very different. Future research in this area should make efforts to delineate the long term effects of the aforementioned interventions, increase size and diversity of the populations being studied, and include long term follow-up for patients with musculoskeletal pain presentations.
DO ALTERED KINEMATICS AND KINETICS IN GAIT INCREASE PREVALENCE OF LOW BACK PAIN IN LOWER-LIMB AMPUTEES COMPARED TO ABLE-BODIED PEOPLE? A SYSTEMATIC REVIEW

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PURPOSE/HYPOTHESIS: Low back pain (LBP) is a common cause of decreased function, lost workdays, and disability in the general population and one of the leading reasons patients seek physical therapy services. This systematic review was designed to investigate the cause of the higher prevalence of LBP in lower limb amputees (LLA) compared to able-bodied people.

MATERIALS/METHODS: In April 2016 we searched Southwest Baptist University’s library database using keywords: low back pain, amputation, and able-bodied people and found 15,598 articles. Limitations were added to bring the number of articles to 2,357; date from 2006 to 2016, peer reviewed articles, academic journals, and English language. These articles were screened by title and 225 records were excluded due to relevance. The final 12 articles were assessed for inclusion of kinematics or kinematics in gait as the cause of LBP in able-bodied people. Specifically, we investigated altered kinematics and kinetics in gait increases the prevalence of LBP in LLA compared to able-bodied people.

NUMBER OF SUBJECTS: One hundred thirty-one.

RESULTS: The 4 studies reviewed were all cross-sectional studies. All 4 studies were analyzed using the modified Downs and Black quality assessment tool. Using the modified Downs and Black assessment tool, 1 study was graded as good quality and 3 were graded as fair quality. Between the 4 studies evaluated, each had different hypotheses as for the cause of LBP in LLA. A majority of the studies found notable alterations during gait in LLA with LBP compared to able-bodied individuals or LLA without LBP. Gait alterations included differences in transverse, sagittal, or frontal plane motion, muscle activation, and forces applied through the lower extremities.

CONCLUSIONS: Based on the quality and quantity of evidence evaluated in this review, we could not form a definitive conclusion to the cause of LBP in LLA. In addition, the studies failed to consider types of prostheses in their inclusion and exclusion criteria which could cause differences within the LLA group. Transverse plane motion was shown to be significantly different between LLA with LBP and both able-bodied individuals and LLA without LBP [8]. Another contributor to a higher prevalence in LBP in LLA includes increased spinal loads leading to cocontraction and fatigue failure [6] of trunk musculature. Future research is needed to assess asymmetries between LLA with LBP and able-bodied individuals with LBP. In addition, research is needed to examine the differences in the prevalence and cause of LBP between transistabial and femorotibial amputees.

CLINICAL RELEVANCE: While we cannot identify specific asymmetries as the cause of LBP in LLA, we can surmise that altered kinematics and kinetics may contribute to the higher prevalence of LBP in LLA based on the research. Clinicians must be aware of an increased risk of LBP in LLA and work to eliminate as many asymmetries as possible and increase core strength to counteract any residual asymmetries and abnormal spinal loads present.
tance of fitness of managers to the overall fitness of the employees in each mangers department. A combination of job task specific fitness testing following the NFPA 1582 fitness guidelines and a survey of managers perceived importance of fitness was used to collect data.

SUMMARY OF USE: This study reviewed the fitness testing results of 243 firefighters from 7 different city and county fire departments over a 4-year period and compared the overall fitness levels of each department’s fire fighters to the fitness level of the department’s Fire Chief and Deputy Chief and their perceived importance of fitness. This study found that there was a high correlation between the individual fitness level of the department’s Fire Chief and Deputy Chiefs to the overall fitness level of the individual fire fighter in each department but a low correlation between the Fire Chiefs and Deputy Chiefs perceived importance of fitness and the overall fitness levels of the individual fire fighter in each department.

IMPORTANCE TO MEMBERS: This study suggests that a key factor on the overall fitness of public employees with highly physical jobs like fire fighters, is the fitness level of the department’s Fire Chief and Deputy Chief and not their perceived importance of fitness. This information can be useful in promoting health and wellness in the workplace by identifying the key role that department leaders play in promoting health and wellness to the individual employee by being fit themselves.

OP083
CERVICAL TRACTION TRAINING PROGRAM: UTILIZING BIOFEEDBACK AND MOTOR LEARNING PRINCIPLES

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PURPOSE/HYPOTHESIS: Manual cervical traction (MCT) is a common intervention used by physical therapists to treat persons with neck pain and the cervical distraction test assists with the diagnosis of radiculopathy or zygapophysial joint irritation by reducing the compression on irritated structures. The therapeutic range of cervical traction is reported to be between 11.34 and 18.14 kg. A previous study demonstrated only 19% of novice clinicians and 73% of “master clinicians” (P<.01) produce the appropriate amount of force. The purpose of this study was to evaluate the effectiveness of a MCT training protocol using biofeedback and motor learning principles to improve students’ ability to apply the appropriate amount of force during MCT.

NUMBER OF SUBJECTS: Seventeen recruited, 11 in the training portion.

MATERIALS/METHODS: Third year doctor of physical therapy students from 1 university were recruited. Inclusion criteria included completion of one 8-week outpatient orthopaedic clinical experience and performance of MCT with patients. Participants completed MCT on a mannequin head/neck attached to the BTE Primus RS instrumented dynamometer. Participants who did not perform MCT within the recommended range of force, 11.34 to 18.14 kg, were enrolled in the training portion of the study. Training consisted of 3 phases of a faded auditory and visual feedback protocol schedule. Participants were posttested 24 to 72 hours following the training session. Average peak force of three 20-second trials was recorded.

RESULTS: There was significantly more average force of pull posttest (17.44 kg) compared to pretest (9.88 kg) (P<.01). Five of 17 (29%) subjects pulled with the correct amount of force during pretesting and post testing results demonstrated 7/11 (72.7%) students pulled with the correct amount of force. There was a direct association between the training and the participant’s ability to pull within the appropriate range of force (P = .01).

CONCLUSIONS: The present study demonstrated 29% of students pull with the correct amount of force during MCT. This is in close agreement from a previous study that reported 39% of students. One motor learning-biobackground training session was effective in teaching 72.7% of students MCT.

CLINICAL RELEVANCE: Clinical practice guidelines recommend MCT as an intervention for persons with neck pain and valid results of the cervical traction test are dependent on practitioners pulling with enough force to cause vertebral separation. This study demonstrated an effective training technique for proper performance of MCT. A 1-day training session that used motor learning principles and knowledge of results allowed physical therapy students to perfect their MCT skills. The training produced the same percentage of participants that pulled within the correct range as previously reported for “master clinicians” (73%). Future research should investigate the effectiveness of utilizing biofeedback and motor learning principles to efficiently teach other manual therapy techniques.

OP084
PHYSICAL THERAPY REHABILITATION AFTER LONG-TERM CERVICAL IMMOBILIZATION FOLLOWING ATLAS (JEFFERSON) FRACTURE: A CASE REPORT

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BACKGROUND AND PURPOSE: Fractures of the atlas (C1), though estimated to be as low as 3% of spinal injuries, have a reported mortality rate as high as 11.7%. Typical mechanism is axial loading at the top of the head with a resultant burst fracture, or Jefferson fracture, with or without cervical ligamentous rupture. Often there is no neurological involvement secondary to the width of the spinal canal at the level of C1. Medical management of the dynamic instability requires cervical fusion and/or long-term immobilization. Common patient complaints following medical intervention include pain, stiffness, and limited cervical range of motion (ROM). Minimal evidence exists for rehabilitation following spinal stabilization after a Jefferson fracture. This case report describes the physical therapy (PT) interventions and outcomes of a patient after cervical immobilization following a Jefferson fracture.

CASE DESCRIPTION: Patient was a 49-year-old woman who sustained a Jefferson fracture while in a motor vehicle accident where she rolled her car landing upside down. She was treated conservatively for 7 months in a halo vest with bone stimulator and subsequently with a rigid cervical collar. Patient was referred to PT after the immobilization with initial impairments of decreased cervical ROM, lack of cervical muscle flexibility and strength, cervicothoracic and rib joint hypomobility, impaired posture, reports of “muscular pain,” and functional limitations in driving. Interventions included joint mobilizations targeting the lower cervical spine and ribs and soft tissue mobilizations to the suboccipital region, scalene and trapezius muscles. Exercise progression included postural correction, deep neck flexor training, and upper extremity resistance training.

OUTCOMES: The patient was seen for 25 PT sessions with interventions focused on manual therapy and exercise. She demonstrated improvements in all her cervical active ROM: flexion from 0° to 10° to 0° to 50°, extension 0° to 0° to 46°, right (R) rotation 0° to 25° to 0° to 60°, and left (L) rotation 0° to 18° to 0° to 55°. Her upper extremity strength improved to grossly 5/5 with manual muscle testing. Grip strength increased: (R) 40 to 54 lb, (L) 38 to 47 lb. Further, her average “muscular pain” on the numeric pain-rating scale improved from 4/10 to 0/10. She returned to all work and all daily activities without limitation. Patient returned to driving with the soft collar per the physician’s instruction.

DISCUSSION: Orthopaedic manual physical therapy (OMPT) treatment directed at the lower cervical spine/rib joints and soft tissue interventions, with follow-up therapeutic exercise, resulted in functional improvements after long-term cervical immobilization following a Jefferson fracture. While there is minimal evidence on the best PT treatment approach following Jefferson fractures, clinical reasoning facilitated the direction and use of OMPT and therapeutic exercise.


OP085
RELIABILITY OF ULTRASOUND MEASURES OF INTRINSIC FOOT MOTOR FUNCTION
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PURPOSE/HYPOTHESIS: The intrinsic foot muscles (IFM) play an important role in the shaping of the foot [1,2], force attenuation [1,3], and force transmission [1,5] during propulsion. Currently, clinically accessible assessment of IFM function and size has been limited to the IFM test [4] and resting ultrasound (US) imaging measures [5]. Reliability has yet to be established for innovative measures of IFM function under US imaging dynamic activity. The purpose of this study was to establish test-retest reliability of US measures of IFM size and motor function.

NUMBER OF SUBJECTS: Data from 24 healthy, recreationally active individuals ages 18 to 50 with no history of ankle or foot sprain or fracture were included (12 male, 12 female; mean ± SD age, 21.5 ± 4.8 years; BMI, 23.5 ± 2.9 kg/m²).

MATERIALS/METHODS: Participants were imaged on 2 separate days by a physical therapist with 14 years of clinical experience and 2 months of experience using US imaging. Washout period between test sessions was 3 to 10 days. US cross section area (CSA, cm²) and thickness (cm) of the right (RT) and left (LT) abductor hallucis (AbdH), flexor digitorum brevis (FDB), quadratus plantae (QP), and flexor hallucis brevis (FHB) were measured at rest and during active contraction, while resisted, and while performing toe spread, isolated hallux extension, and lesser toe extension exercises. Contracted measures were normalized to resting values and represented as activation ratios. Reliability was assessed with intraclass coefficients (ICC model 2,k), with greater than 0.75 interpreted as being excellent, 0.40 to 0.75 as fair to good, and less than 0.40 as poor [6].

RESULTS: Reliability of resting US measures of AbdH CSA (Baseline RT, 2.66 ± 0.64 cm²; LT, 2.63 ± 0.57 cm²; Final RT, 2.66 ± 0.60 cm²; Final LT, 2.67 ± 0.54 cm²; ICC = 0.98-0.97) and thickness (Baseline RT, 1.25 ± 0.20 cm; LT, 1.26 ± 0.19 cm; Final RT, 1.28 ± 0.21 cm; LT, 1.25 ± 0.21 cm; ICC = 0.88-0.91), FDB CSA (Baseline RT, 1.87 ± 0.52 cm²; LT, 1.81 ± 0.44 cm²; Final RT, 1.77 ± 0.46 cm²; LT, 1.80 ± 0.42 cm²; ICC = 0.93-0.91) and thickness (Baseline RT, 0.84 ± 0.19 cm; LT, 0.80 ± 0.15 cm; Final RT, 0.81 ± 0.16 cm; LT, 0.76 ± 0.14 cm; ICC = 0.87-0.89), QP CSA (Baseline RT, 1.47 ± 0.59 cm²; LT, 1.40 ± 0.51 cm²; Final RT, 1.47 ± 0.61 cm²; Final LT, 1.47 ± 0.58 cm²; ICC = 0.97-0.98) and thickness (Baseline RT, 0.91 ± 0.18 cm; LT, 0.91 ± 0.15 cm; Final RT, 0.90 ± 0.17 cm; LT, 0.94 ± 0.18 cm; ICC = 0.90-0.92), and FHB CSA (Baseline RT, 3.00 ± 0.69 cm²; LT, 2.99 ± 0.85 cm²; Final RT, 2.97 ± 0.68 cm²; LT, 2.97 ± 0.83 cm²; ICC = 0.95-0.98) and thickness (Baseline RT, 1.42 ± 0.22 cm; LT, 1.38 ± 0.18 cm; Final RT, 1.38 ± 0.39 cm; LT, 1.38 ± 0.19 cm; ICC = 0.76-0.83) were excellent. During function, reliability of active, resisted and toe exercise CSA measures was excellent (ICC = 0.81-0.99) and good to excellent (ICC = 0.66-0.93) for thickness measures.

CONCLUSIONS: US measures of IFM function were found to have good to excellent reliability.

CLINICAL RELEVANCE: These measures may have utility in patient care and clinical research and should be considered as a potential outcome measure.

OP086
RELIABILITY OF MEASURES OF ANKLE-FOOT MORPHOLOGY, MOBILITY, AND STRENGTH
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PURPOSE/HYPOTHESIS: Lateral ankle and midfoot sprains result from high velocity moments and extremes of plantarflexion, adduction, and inversion of the foot [1-3]. Clinical assessment of foot posture, morphology, intersegmental mobility, and strength of the ankle-foot complex following sprain is recommended for instruction in physical therapy education programs [4] and in practice [5]. The purpose was to determine test-retest reliability and interrater reliability of innovative and established clinical measures of morphologic, joint excursion and accessory motion, and strength of the ankle-foot complex. We hypothesized reliability to be excellent for morphologic measures, fair to good for joint excursion and strength, and poor for joint accessory measures.

NUMBER OF SUBJECTS: Data from 24 healthy, recreationally active individuals aged 18 to 50 with no history of ankle or foot sprain or fracture were included (12 male, 12 female; mean ± SD age, 21.5 ± 4.8 years; BMI, 23.5 ± 2.9 kg/m²).

MATERIALS/METHODS: Participants were assessed by 2 clinicians (a physical therapist with 14 years of experience and an athletic trainer with 2 years of experience) on 2 separate days. Order of clinician assessment was randomized using a Latin-square. Washout period between test sessions was 3 to 10 days. Foot posture and morphology was assessed using the Foot Posture Index and measures of foot length, width, truncated length and arch height. Joint mobility was assessed using goniometry (rearfoot and hallux excursion), inclinometry (forefoot), linear measures of sagittal excursion (first ray and loaded rearfoot), and rating of joint accessory motion. Strength was assessed using handheld dynamometry. Reliability was assessed with intraclass coefficients (ICC model 2,k), with greater than 0.75 interpreted as being excellent, 0.40 to 0.75 as fair to good, and less than 0.40 as poor [7].

RESULTS: Test-retest reliability was excellent in all posture and morphologic measures (0.80-1.00), talocrural (0.81-0.97) and hallux (0.82-0.95) joint excursion measures, fair to excellent for first ray sagittal excursion (0.82-0.90) and frontal plane rearfoot (0.58-0.73) and forefoot (0.72-0.86) excursion, and strength (0.67-0.92) measures. Interrater reliability of joint accessory motion (−0.67 to 0.84) varied on clinical experience, with the more experienced clinician demonstrating greater consistency (67% of measures greater than 0.40) compared the novice clinician (36% of measures greater than 0.40). Interrater reliability was excellent in morphologic measures (0.81-1.00) and talocrural (0.76-0.97) and hallux (0.85-0.91) excursion measures, fair to excellent in forefoot (0.66-0.86) excursion and strength measures (0.53-0.90), fair to good in rearfoot frontal plane excursion (0.53-0.69), poor to good in hallux excursion (0.32-0.53), and poor (−1.06 to 0.39) in 73% of joint accessory measures.

CONCLUSIONS: Measures of ankle-foot posture, morphology, joint excursion, and strength demonstrated fair to excellent test-retest and interrater reliability. Joint accessory measures had poor to fair agreement overall.

CLINICAL RELEVANCE: These findings should be considered when selecting ankle-foot assessment measures.

OP087
THE INFLUENCE OF TENSION AND SLIDING TECHNIQUES ON NEURODYNAMIC DYSFUNCTION IN THE CONTRALATERAL EXTREMITY
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PURPOSE/HYPOTHESIS: To determine if neural tissue management, via sliding or tensioning of the least neurodynamically involved upper extremity...
influences function of the contralateral extremity in individuals with median or ulnar nerve dysfunction

NUMBER OF SUBJECTS: Forty-two college students (15 male, 27 female) who demonstrated a positive Upper Limb Neural Tension Test (ULNNT) for either the median or ulnar nerve.

MATERIALS/METHODS: Subjects completed an informed consent, demographic information sheet, Neck Disability Index (NDI), and Disabilities of the Shoulder and Hand Questionnaire (QuickDASH) prior to screening before being randomly assigned to either a tensioning (n = 11), sliding (n = 9), combination of tensioning and sliding (n = 11), or control (n = 11) group for treatment. Outcome measures included cervical range of motion (ROM), grip and pinch strength, and upper limb tension test (ULTT) of the median (extension range of motion at the elbow) and ulnar (abduction range of motion at the shoulder) nerves. Tensioning, sliding, and combination groups received a home exercise program (HEP) to perform 2 minutes per day for 2 weeks. Tensioning is defined as a technique to increase tension in neural structures by stabilizing the nerve at 1 point and elongating at another point. Sliding is defined as an technique to produce sliding of neural structures relative to their adjacent tissues. Sliding is produced by elongating the nerve at 1 point and shortening at another to create the sliding motion. The control group was advised to continue their usual activities. ULTT restrictions were assessed goniometrically during elbow extension (for median nerve) and shoulder abduction (for ulnar nerve) at the point in the ROM where symptoms were provoked. Grip and pinch strength were assessed using a handheld dynamometer (setting 2). The mean of 3 successive trials was used for analysis.

RESULTS: No statistically significant differences were found among treatment groups on any outcome variable prior to the intervention. No statistically significant changes in any outcome measures were found in the contralateral arm (P > .05), although positive trends were observed in median and ulnar ROM in the tensioning group.

CONCLUSIONS: Neurodynamic treatment of the opposite extremity did not produce a significant change in the neurodynamic function as measured by range of motion and strength of the contralateral limb.

CLINICAL RELEVANCE: Neurodynamic treatment through tensioning, sliding, or a combination of both using the opposite extremity is not effective. The extremity with median or ulnar neurodynamic dysfunction is where treatment should be directed.

OP089

EXAMINATION OF ACROMIOHUMERAL DISTANCE IN UPRIGHT AND SELF-SELECTED SEATED POSTURES USING REAL-TIME ULTRASOUND IMAGING IN NORMAL HEALTHY SUBJECTS

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PURPOSE/HYPOTHESIS: The subacromial space, a common site of shoulder impingement, pain, and dysfunction can be assessed by measuring the acromiohumeral distance (AHD). A decrease in the AHD can lead to an increase in the risk of impingement, which can lead to pain and disability. Postural changes have been theorized to impact AHD. The purpose of this study was to examine the relationship between AHD and varying degrees of shoulder abduction in self-selected (SSP) and standardized upright seated posture (USP) using Real-Time Ultrasound (RTUS).

NUMBER OF SUBJECTS: Thirty-four normal subjects (mean age, 25 years; 22 male, 12 female).

MATERIALS/METHODS: Anthropometric measurements were obtained and maximal grip strength was assessed. Subjects were screened for scapular stability and impingement using standardized clinical tests. Ultrasound images of AHD were captured with the arm at rest and at 30°, 45°, and 60° abduction with the subject in SSP and in USP. The AHD was determined to be the linear distance between the “last” visible point of the humerus and the highest point of the acromion process. Intraexaminer reliability between sessions using 10 subjects was measured and resulted in ICC values ranging from 0.85 (CI: 0.81, 0.89) to 0.95 (CI: 0.82, 0.99) for SSP and 0.92 (CI: 0.88, 0.97) to 0.97 (CI: 0.89, 0.99) for USP. All analyses were performed with SPSS Version 21.

RESULTS: Statistical analysis showed no significant differences in AHD between SSP and USP positions. Within SSP, AHD at rest (1.31 ± 0.20 cm) was significantly larger than 30° (1.18 ± 0.25 cm), 45° (1.09 ± 0.22 cm), and 60° (1.03 ± 0.20 cm) abduction and AHD at 30° abduction was significantly larger than 45° and 60°. Within USP, AHD at rest (1.30 ± 0.19 cm) was significantly larger than 30° (1.21 ± 0.24 cm), 45° (0.99 ± 0.23 cm), and 60° (1.01 ± 0.19 cm) abduction and AHD at 30° abduction was significantly larger than 45° and 60° abduction. No significant differences in AHD were found between 45° and 60° abduction within either SSP or USP.

CONCLUSIONS: These results provide evidence suggesting that posture may not have a significant effect on AHD and therefore may not be a primary cause of subacromial impingement. AHD appears to be largest at rest (0°...
abduction) and smallest at 45° abduction. However, due to the limitation of measuring abduction past 45° with RTUS, future research is needed to confirm these results.

CLINICAL RELEVANCE: The practice of RTUS allows PTs to observe neuromuscular structures in real time and during various physiological movements. Through our background and clinical knowledge, posture can have an effect on impingement syndrome in the GH joint. By observing this in the clinic, PTs can note the PTs posture in the examination process and use the RTUS to observe any SAS narrowing that could be contributing to the impingement. Our data suggest that posture may have a small to minimal effect on subacromial space and shoulder impingement, but given our limitations, more research is needed to further investigate the effects of posture on AHD.

OP091

DIFFERENTIAL DIAGNOSIS FOR ANTERIOR KNEE PAIN UTILIZING MECHANICAL DIAGNOSIS AND THERAPY

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BACKGROUND AND PURPOSE: Research shows that determining a pathoanatomical diagnosis for non-red flag musculoskeletal conditions is challenging. The McKenzie Method of Mechanical Diagnosis and Therapy (MDT) has been found to be a valid and reliable assessment approach for the spine and is undergoing initial trials in the extremities. MDT attempts to classify patients into distinct subgroups based on a thorough history and symptomatic and mechanical response to different loading strategies. The treatment is tailored to the patient based on the classification. This case highlights the utility of MDT to differentially diagnose between 2 classifications and provide an effective treatment.

CASE DESCRIPTION: The patient was a 20-year-old man who presented with a diagnosis of bilateral patellar tendinitis. He reported an onset of bilateral anterior knee pain which began 3 years ago when he landed hard while playing basketball. He felt as though the condition was worsening because he could no longer play basketball or squat. Additional aggravating factors included prolonged sitting and ascending stairs. At the completion of the history a provisional MDT classification of contractile dysfunction and derangement were possible. Contractile dysfunction is considered to be structurally compromised contractile soft tissue which is analogous to chronic tendinopathy. The hallmark of dysfunction is consistency of pain which is only produced when the dysfunctional tissue is sufficiently loaded. Derangement is the clinical presentation associated with a mechanical obstruction of an affected joint. Directional preference is an essential feature and variability is the hallmark symptom behavior. The physical exam that followed was structured to help differentiate between the 2. Primary concordant baselines included end range pain with passive knee flexion, end range pain and obstruction of passive knee extension, patellar tendon tenderness to palpation, pain and weakness with knee extension manual muscle testing, pain with ascending stairs, and painful squat limited to 90°. Screen of the lumbar spine was negative. Repeated end-range patient-generated knee extension techniques produced clinically significant changes in all concordant baselines. Due to rapid change of baselines in response to a specific directional preference, provisional classification of derangement was made. The patient was seen for 4 sessions over the course of 6 weeks. During this time all baselines were normalized.

OUTCOMES: Initial LEFS: 35/80. The patient was contacted 2 weeks after his final appointment. He reported having played in basketball tournament without limitations and that he continues to use his specific directional preference exercise to keep the knees feeling good. Final LEFS: 80/80.

DISCUSSION: This case demonstrates the importance of classification to help guide treatment. Thoughtful mechanical testing allows the clinician to understand the true nature of a condition. In this case, classification of derangement led to rapid resolution of a chronic worsening condition.


**OP092**

**RELIABILITY OF HIP ROTATION RANGE OF MOTION IN SUPINE AND SEATED POSITIONS**

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**PURPOSE/HYPOTHESIS:** Hip rotation range of motion (ROM) is a commonly assessed in individuals with hip pathology. While supine and seated hip rotation range of motion testing positions are both common, it remains unknown which testing position has optimal reliability. Therefore, the purpose of this study was to compare inter and intrarater reliability between hip internal and external rotation in the supine and seated positions in experienced and novice practitioners.

**NUMBER OF SUBJECTS:** Nineteen participants without hip, knee, or lumbar spine pain (11 female, 8 male; mean ± SD age, 23.5 ± 1.2 years).

**MATERIALS/METHODS:** Three testers (one with 10 years of orthopaedic physical therapy experience and 2 first year physical therapy students) performed 2 testing sessions (3-7 days between sessions). Passive external and internal rotation ROM was measured using a standard goniometer. Measures were obtained on both right and left limbs in 2 positions: supine and seated (hip and knee in 90° of flexion). Interrater and intrarater reliability were calculated in SPSS using interclass correlation coefficients (ICC). Minimal detectable change (MDC) was also calculated (standard error of the measure \( \times 1.96 \times \sqrt{2} \)).

**RESULTS:** Interrater reliability for supine hip external and internal rotation ROM were good to excellent (ICC = 0.62-0.87 [right and left] and 0.70-0.88, respectively). Between session intrarater reliability for supine hip external and internal rotation ROM was excellent for all raters (ICC = 0.77-0.96). Interrater reliability was fair to excellent for seated hip external rotation ROM (ICC = 0.52-0.79) and was good for seated hip internal rotation ROM (ICC = 0.60-0.68). In the seated position, intrarater reliability for hip external rotation ROM was excellent for the experienced clinician (ICC = 0.81-0.83) and fair to excellent for the novice clinicians (ICC = 0.52-0.94). Seated hip internal rotation ROM intrarater reliability was good to excellent for the experienced clinician (ICC = 0.61-0.77) and was fair to excellent for the novice clinicians (ICC = 0.59-0.82). MDC values among the 3 testers were as follows: supine hip external rotation ROM, 4.5°-10.5°; supine hip internal rotation ROM, 4.5°-11.3°; seated hip external rotation ROM, 4.2°-8.0°; and seated hip internal rotation ROM, 5.6°-11.5°.

**CONCLUSIONS:** Overall, both seated and supine hip rotation ROM measures had fair to excellent reliability between and within testers. However, hip rotation measured in supine had slightly higher inter and intrarater values, particularly for the novice clinicians. The MDC values did not vary substantially between seated and supine hip rotation ROM.

**CLINICAL RELEVANCE:** This study demonstrated reliability and MDC values of supine and seated hip rotation ROM testing for experienced and novice clinicians. This is important clinically because hip rotation ROM is a common measurement used to evaluate persons with hip pathology. Furthermore, this study suggests that the supine testing position may be more reliable than the seated position and may be the optimal choice, particularly for novice clinicians.

**OP093**

**NORMAL SENSORY RESPONSE AND DISTRIBUTION OF THE STRAIGHT LEG RAISE TEST ON ASYMPTOMATIC INDIVIDUALS**

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**PURPOSE/HYPOTHESIS:** The straight leg raise (SLR) is a passive test commonly used to assess neurodynamic function in the lower extremity. To date, there is a lack of research describing the quality, quantity, and distribution of normal sensory response associated with the SLR test. The purpose of our study was to examine the normal sensory response and distribution of the SLR test on asymptomatic individuals. We hypothesized that: (1) the sensory response would be along the sciatic nerve distribution and its distal tributaries, (2) no significant difference in sensory response would exist between limbs.

**NUMBER OF SUBJECTS:** Forty-seven.

**MATERIALS/METHODS:** This was a cross-sectional study. The range of motion, quantity, quality, and distribution of sensory responses were measured in 47 asymptomatic individuals during the SLR test. Passive ankle dorsiflexion and passive neck flexion were used as neural sensitizing maneuvers.

**RESULTS:** The total means ± SD of sensory responses for the left and right lower extremities were respectively as follows: stretching was 6.25 ± 1.75 and 6.63 ± 2.09 cm; burning was 4.28 ± 3.07 and 6.70 ± 5.39 cm; tingling was 2.65 ± 3.06 and 2.63 ± 3.05 cm; and numbness was 2.80 ± 0.14 and 0.60 ± 0.14 cm. The sensation of stretch was the most prominent response (96%) of those experienced. The distribution and frequency of sensory response for the left and right lower extremities were respectively as follows: posterior thigh was 74% and 74%; posterior knee was 26% and 32%; posterior calf was 21% and 34%; and plantar foot surface 2% and 4%. The frequency at which passive ankle dorsiflexion increased the local sensory response intensity was 98% for the left lower extremity and 89% for the right lower extremity. Finally, the frequency at which passive neck flexion increased the local sensory response intensity was 11% for both lower extremities.

**CONCLUSIONS:** The results of this study provide evidence that there are no significant differences in sensory response between limbs during the SLR test in asymptomatic individuals. Sensory responses were along the sciatic nerve distribution and its distal tributaries. The results also suggest passive ankle dorsiflexion acts as an effective neural sensitizing maneuver when performing the SLR test.

**CLINICAL RELEVANCE:** The clinical implications of these findings suggest that therapists should expect sensory responses during SLR testing to follow the sciatic nerve distribution and to confirm the suspicion of nerve tissue involvement with passive ankle dorsiflexion.

**OP094**

**CLINICAL DECISION MAKING WITH AN UNDIAGNOSED POSTTRAUMATIC TYPE I FRACTURE OF THE RADIAL NECK**

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**BACKGROUND AND PURPOSE:** Posttraumatic type I fractures of the radial neck should be considered as potential acute injuries of the arm with an aging and labor intensive workforce. A physical therapist’s (PT) knowledge of an abnormal patient presentation in addition to the use of evidence-based tools is beneficial towards the clinical decision making of musculoskeletal-related injuries.

**CASE DESCRIPTION:** A 60-year-old female housekeeper experienced height-ened pain in her right elbow after catching her left foot in a bed skirt and suffering a fall onto her right elbow. Initial X-rays (3 views) that were taken the day after her injury were found negative for fracture and/or
The reliability of measurements used to quantify frontal plane knee valgus motion during the landing phase of a single limb hop in asymptomatic participants using the iPad application SparkMotion (SparkMotion, LLC).

**NUMBER OF SUBJECTS:** Thirty asymptomatic adult participants, 14 male and 16 female.

**MATERIALS/METHODS:** Participants meeting inclusion criteria completed a demographic questionnaire reporting their age, height, body mass, and dominant leg. Two investigators independently observed a video of a subject performing the single-leg hop test with a standardized landing point in real time and estimated the degree of knee valgus at the terminal point where eccentric momentum ended. Then, investigators watched the video again using the software to pause the video at the terminal point and measured the amount of knee valgus with a virtual goniometer tool. Each of the 30 subjects performed the test 3 times on each leg for a total of 6 jumps. The reliability was evaluated by the intraclass correlation coefficient (ICC) model 3,k for the intrarater component of analysis and model 2,k for the interrater analysis. Model 2,k was used to determine if the SparkMotion can be used with confidence and reliability among equally trained clinicians.

**RESULTS:** ICCs for visual estimate of dominant leg were 0.90; ICC for visual estimate of nondominant leg was 0.87; ICC SparkMotion dominant leg was 0.85; ICC SparkMotion nondominant leg = 0.91. The concurrent validity between visual and SparkMotion had an ICC value of 0.91 for rater A and 0.86 for rater B.

**CONCLUSIONS:** The results show higher interrater reliability with the use of the SparkMotion application compared to visual estimate alone; however, the visual estimates still showed moderate to high reliability with ICC values. To our knowledge, this is the only study to evaluate the single-leg hop test utilizing a 2-D application. Results may not be generalized to symptomatic cohorts; however, the utility of these findings support reliability for potential screenings purposes.

**CLINICAL RELEVANCE:** The results of our study support the use of real-time video observation as a reliable measurement of frontal plane knee kinematics; however, video-based measurements utilizing an app that can slow movement and measure angles via a virtual goniometer offer greater reliability. Moreover, real-time visual estimation of video may offer comparable correlation and agreement to analysis utilizing specific movement analysis applications (eg, video goniometric).
Patient education is crucial in the patient’s choice of treatment for de-}

it can still serve to provide the patient with presurgical strengthening.

from further degenerative processes such as the progression of osteoar-

thrisis. If conservative therapy is ineffective in reducing patient symptoms,

it can still serve to provide the patient with presurgical strengthening.

Education is crucial in the patient’s choice of treatment for de-

gerative meniscal tears. Future research on this topic is recommended.

TRIGGER POINT DRY NEEDLING FOR A PATIENT PRESENTING WITH

PLANTAR FASCITIS FOLLOWING SURGICAL REMOVAL OF A STIEDA

PROCESS AND STABILIZATION OF A TALAR FrACTURE: A CASE STUDY

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BACKGROUND AND PURPOSE: Plantar fasciitis is a common musculoskeletal
disorder of the foot with a lifetime incidence of 10% afflicting both sed-

imentary and highly active individuals. Trigger point dry needling (TDN) is a treatment for individuals experiencing musculoskeletal pain with limited
evidence for its effectiveness in individuals with plantar fasciitis. The purpose of this case study is to describe outcomes associated with the use of TDN as a supplemental intervention for a patient presenting for post-

surgical rehabilitation in whom rehabilitation was limited by the develop-

ment of plantar fasciitis associated with prolonged use of a walker boot.

CASE DESCRIPTION: The patient was a 36-year-old man who presented to physical therapy for postoperative rehabilitation following surgical re-

moval of a Stieda process and stabilization of a talus fracture. The patient was seen for 8 weeks of physical therapy directed by a standard post oper-

ative protocol and was progressing as expected. At this time, the patient
developed signs and symptoms consistent with plantar fasciitis pain pre-

venting progression and necessitating continued use of the post operative boot. Pain was rated as an 8/10 using a numeric pain rating scale and his Lower Extremity Functional Scale was 58/80. Trigger points were identified in the adductor hallucis and flexor hallucis muscles and TDN was ini-
tiated to these areas for 2 sessions over a 2-week period.

OUTCOMES: Following 2 TDN treatments, patient reported 0/10 on pain and scored 80/80 of the LEFS which translated to 100% of maximal function, and was able ambulate without the post operative boot with full weight-bearing on his affected extremity.

DISCUSSION: The addition of TDN to a standard physical therapy pro-

gram was associated with complete functional recovery and absence of pain upon discharge in a patient in whom postoperative rehabilitation was limited by the onset of plantar fasciitis. This case is novel in describ-
ing the supplemental use of TDN in a patient in whom the development of plantar fasciitis limited to return function following an unrelated surgical procedure.

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OP099
KINEMATIC ANALYSES OF THE TEMPOROMANDIBULAR JOINT DURING FUNCTIONAL MOVEMENTS AND JOINT MOBILIZATION: A CADEVERIC STUDY
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PURPOSE/HYPOTHESIS: Temporomandibular disorder (TMD) is characterized by pain and dysfunction of the temporomandibular joint (TMJ) and muscles of mastication. It affects 6% to 12% of the adult population [1]. Joint mobilization has been employed for managing TMD [2]. Recent reviews in the management of TMD failed to identify high-quality evidence and certainty of effectiveness for manual therapy [3,4,5]. No existing literature has analyzed the biomechanical characteristics of TMJ mobilizations, therefore, purposes of this study were to investigate the kinematics of TMJ during jaw functional movements and during TMJ mobilization.
NUMBER OF SUBJECTS: Nine fresh cadaveric head specimens were used.
MATERIALS/METHODS: The specimen was mounted on a test frame with a 6-axis load cell. A Vicon Motion Analysis System was used to track movements of TMJ. Functional movements (jaw opening, protrusion, retraction, and lateral deviations) were performed passively by a TMD specialist (SH). Unilateral inferior glide with anteromedial translation (UIGAT), bilateral inferior glide with anterior translation (BIGAT), inferior glide with anterior rotation (IGAR), inferior glide with posterior rotation (GPAR), and lateral glide were performed. Jaw movements were tested again at the end of the experiment. The condylar rotation and translation of both left (LC) and right condyle (RC) were analyzed.
RESULTS: During passive jaw opening the condyle rotated 16.1° ± 3.0° and moved anteriorly (LC, 1.88 ± 1.89 mm; RC, 2.24 ± 1.42 mm) and inferiorly (LC, 3.87 ± 1.77 mm; RC, 3.53 ± 2.18 mm). During passive jaw deviation to the left, the left condyle moved posteriorly (1.04 ± 0.82 mm), laterally (1.34 ± 0.44 mm), and superiorly (0.71 ± 0.59 mm) and the right condyle moved anteriorly (1.32 ± 0.87 mm), mediadly (1.35 ± 0.48 mm), and inferiorly (0.91 ± 0.54 mm). Similar patterns of condylar movements were observed during passive jaw deviation to the right. UIGAT and BIGAT produced anterior translation (2.59 ± 1.75 mm and 2.08 ± 0.97 mm) and inferior translation (1.72 ± 0.64 mm and 1.58 ± 0.52 mm) of the condyle. UIGAT and lateral glide produced lateral translation (1.61 ± 0.66 mm and 0.83 ± 0.44 mm). There were significant increase of condylar rotation (P = .008) and translation in the anterior (P = .011 in LC) and inferior directions (P = .021 in both LC and RC) between pre and posttest of jaw opening.
CONCLUSIONS: During functional movements and TMJ mobilizations directions of condylar rotation and translation were consistent with intend applications [2]. Results of the present study also suggest that UIGAT and BIGAT can be applied if anterior or inferior movement of the condyle or if jaw opening is limited and UIGAT and lateral glide, if the lateral movement of the condyle is limited.
CLINICAL RELEVANCE: This study presented the kinematics of TMJ during functional jaw movements and during TMJ mobilization and therefore provided quantitative data for research references and clinical evidence to verify the effectiveness of the TMJ mobilization techniques.

OP010
RELIABILITY OF MEASURING ANTERIOR TRANSLATION OF THE MANDIBULAR CONDYLE DURING MOUTH OPENING USING ULTRASONOGRAPHY
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PURPOSE/HYPOTHESIS: Temporomandibular dysfunction (TMD) is a common orofacial condition, which often leads to restricted mandibular opening. In order for physical therapy intervention to be optimal, it is important to identify arthrokinematic limitations in individuals with TMD. Specifically, anterior translation of the mandibular condyle is a required arthrokinematical component to achieve maximal mouth opening. To date, quantifying TMJ arthrokinematics relies on advanced imaging techniques (eg, computerized tomography [CT] or motion analysis systems), which are expensive and impractical for on-site clinical use. Ultrasonography could provide an inexpensive, more practical means of obtaining measurements of anterior translation of the mandibular condyle. The purpose of this study was to investigate the reliability of using ultrasound (US) imaging for measuring TMJ arthrokinematics (ie, anterior translation of the mandibular condyle) during mouth opening.
NUMBER OF SUBJECTS: Twenty-eight subjects (mean ± SD age, 25.9 ± 4.1 years; 14 male, 14 female) with no current diagnosis of TMD.
MATERIALS/METHODS: During day 1 of data collection, all 28 subjects were asked to repeatedly perform maximal mouth opening while a single examiner placed a linear US transducer overlying the TMJ and the zygoatic arch to record dynamic images of bilateral TMJs. On day 2 of data collection, the same US imaging acquisition procedure was performed on 6 of the subjects that participated in day 1 of data collection. Data analysis was performed to determine (1) imaging processing reliability, and (2) imaging acquisition reliability. Reliability of imaging processing was determined by 3 examiners. Each examiner measured condylar translational distance during mouth opening of 28 subjects on 2 separate days with at least 7 days apart. Averages on each side from both data processing days were analyzed to determine inter and intrarater reliability using intraclass correlation coefficients (ICCs). Standard errors of measurement (SEMs) of each examiner were also calculated. To determine intrarater reliability of US imaging acquisition (ie, transducer placement accuracy), data obtained from day 1 and day 2 of data collection was analyzed using ICs and SEMs.
RESULTS: Data analyses revealed excellent interrater reliability among the 3 examiners for measurements of both TMJs (ICC = 0.989-0.999). Excellent intrarater reliability for imaging processing was also achieved (ICC = 0.960-0.977; SEM, 0.704- 0.871 mm). Data also revealed excellent intrarater reliability for US imaging acquisition (ICC = 0.929-0.939; SEM, 1.234-1.568 mm). CONCLUSIONS: This is the first study assessing the reliability of using US imaging to measure anterior condylar translation in healthy adults. Our data demonstrated that anterior condylar displacement during mouth opening can be measured reliably using our US imaging approach.
CLINICAL RELEVANCE: Our research provides an inexpensive, reliable means of obtaining anterior translation of the mandibular condyle during mouth opening.

OP011
ACUTE EFFECTS OF WALKING ON THE DEFORMATION OF FEMORAL ARTICULAR CARTILAGE
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PURPOSE/HYPOTHESIS: Knee osteoarthritis (OA) is characterized by a progressive loss of the articular cartilage, increasing the amount of friction in the joint, resulting in pain and decreases in mobility and function. Additionally, it has been hypothesized that frontal plane knee malalignment (eg, varus, valgus) is associated with initiation/progression of OA. Previous studies show that static loading of the knee results in more articular cartilage degradation in those with knee OA compared to healthy controls. Static loading of the knee is only proportional to their body weight, where-
as walking produces forces in the knee that are 2 to 3 times body weight. This may result in greater cartilage deformation. The purpose of our study was to compare the acute effects of walking on the femoral cartilage deformation between individuals with and without knee OA and determine whether knee alignment is associated with cartilage deformation.

NUMBER OF SUBJECTS: Ten subjects without OA (5 female, 5 male; mean ± SD age, 55.0 ± 1.8 years; weight, 78.8 ± 14.0 kg; height, 1.8 ± 0.2 m) and 7 subjects with OA (4 female, 3 male; age, 55.4 ± 5.2 years; weight, 94.0 ± 13.1 kg; height, 1.7 ± 0.1 m) were recruited.

MATERIALS/METHODS: Each subject underwent X-ray and magnetic resonance imaging (MRI) assessment. For X-ray assessment, participants with Kellgren-Lawrence grades 2 to 3 were assigned to the OA group whereas subjects with grades 0 to 1 were assigned to the control group. During MRI assessment, 3 T, frontal-plane MRI was obtained before and immediately after 30 minutes of treadmill walking at 3 to 4 mph. Knee alignment was obtained by measuring the angle between the long axes of femur and tibia using a goniometer. To obtain cartilage deformation postwalking, the medial and lateral femoral cartilage of the weight-bearing area was segmented on subjects’ MRI. Cartilage thickness was quantified by computing the average perpendicular distance between opposing voxels defining the edges of the femoral cartilage. Independent t tests were used to compare cartilage deformation (ie, percent changes in medial and lateral cartilage thickness) postwalking between the 2 groups. Pearson correlation coefficients were used to assess the association between cartilage deformation and knee alignment of all subjects.

RESULTS: Independent t tests revealed no significant difference in cartilage deformation between OA group and control group in medial (P = .843) or lateral (P = .660) femur. Pearson correlation coefficient analyses revealed a significant correlation between lateral femoral cartilage deformation and increased knee valgus alignment (r = 0.505, P = .039).

CONCLUSIONS: This is the first study assessing the acute effects of walking on femoral cartilage deformation in persons with and without knee OA. Although there was not a difference in cartilage deformation between the 2 groups, we found that knee valgus was related to lateral femoral cartilage deformation postwalking.

CLINICAL RELEVANCE: Our findings provide further understanding of the relationship of LE alignment and development of OA. This research can impact the interventions for individuals with knee OA.

OP0102
PERSONS WITH PATELLOFEMORAL OSTEOARTHRITIS HAVE REDUCED HIP AND KNEE JOINT VELOCITIES DURING FUNCTIONAL TASKS AND DECREASED PROXIMAL LOWER EXTREMITY STRENGTH
Lisa T. Hoglund, Neil B. Sheth, Joshua R. Orlow, Niraj A. Patel, Michael Polejaev, Laura Pontiggia, John D. Kelly, James Carey


PURPOSE/HYPOTHESIS: Patellofemoral osteoarthritis (PFOA) was reported present in 69% of adults approximately 40 years with chronic knee pain [1]. PFOA causes significant pain and disability [2,3]. Altered lower extremity (LE) biomechanics may contribute to PFOA development or progression. But there are conflicting reports of the presence of aberrant LE biomechanics in persons with PFOA [4-8]. Altered hip or knee joint angular velocity may be an indication of poor LE control, such as valgus LE collapse in persons with patellofemoral pain. The purpose of this study was to examine hip and knee joint peak angular velocities during step-down (StDn) and sit-to-stand (STS) tasks in persons with PFOA versus pain-free controls.

NUMBER OF SUBJECTS: Twenty.

MATERIALS/METHODS: A cross-sectional study compared 10 persons with painful PFOA to 10 age- and sex-matched pain-free adults. The most painful LE of the PFOA group and the same side LE of matched control participants was examined. A motion capture system was used to track LE motion during StDn and STS. Peak hip and knee joint velocities during stance phase were determined. Peak isometric torque of the hip abductors, hip external rotators (ER), hip extensors, and knee extensors were measured with an instrumented dynamometer and normalized by mass and height. Data were analyzed with nonparametric statistics.

RESULTS: Participant median age was 50 years (PFOA group) and 52 years (control group), all were female. Peak hip adduction velocity during StDn and peak knee extension velocity during STS were slower in the PFOA group than the control group (P < .05). All normalized muscle torques were lower in the PFOA group versus the control group (P < .01). Moderate positive relationships existed between hip ER torque and (1) hip flexion velocity during St Dn (r = 0.51, P = .02) and (2) knee abduction velocity during StDn (r = 0.63, P = .003). A moderate inverse relationship existed between hip ER torque and hip internal rotation velocity during StDn (r = .02, P = .02). A moderate inverse relationship existed between peak hip abductor torque and (1) minimal knee flexion velocity during STS (r = .06, P = .003) and (2) minimal hip flexion velocity during STS (r = .047, P = .04).

CONCLUSIONS: Persons with PFOA have reduced hip and knee joint angular velocities during StDn and STS as well as lower peak isometric LE muscle torque. Significant associations between hip ER and hip abductor torques with hip and knee joint velocities indicate that weakness of these muscles may contribute to aberrant LE biomechanics during StDn and STS. The negative association between hip ER torque and hip internal rotation velocity during StDn indicates that hip ER weakness may contribute to poor LE control during stair descent in persons with PFOA.

CLINICAL RELEVANCE: Persons with PFOA have proximal LE muscle weakness and reduced LE joint angular velocities during tasks of stair descent and STS. Future research should study the effect of a strengthening program for persons with PFOA on joint velocities and pain during functional tasks.

OP0103
DOES THE PRESENCE OF RADIATING PAIN IN A COHORT OF CARE-SEEKING PATIENTS WITH NECK PAIN INFLUENCE OUTCOME?
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PURPOSE/HYPOTHESIS: Previous literature has established the presence of radiating pain in patients with neck pain as a prognostic indicator for worse outcome. The purpose of this analysis of a cohort of patients is to establish if difference exists in duration of care and outcomes in patients presenting to physical therapy with nonradiating and radiating neck pain.

NUMBER OF SUBJECTS: The nonrandomized comparative study involved a cohort of 200 patients with neck pain with or without radiating upper extremity symptoms who received guideline oriented care by physical therapists over a 3-year period.

MATERIALS/METHODS: The data included patients who were seen via direct access or through referral. Baseline measures of pain, disability (Neck Disability Index), depression and quality of life were captured for each subject. Final outcomes measures captured include pain and the NDI. Comparative analyses between groups were performed for all baseline measures (using a t test/chi-square) and for discharge percentage change scores for pain and disability (using an analysis of covariance [ANCOVA]; α = .05).

RESULTS: Of the 200 patients enrolled, 135 (67.5%) had neck back pain without radiation and 65 (32.5%) had radiating symptoms. No differences existed age of patients in each group. Differences existed in number of PT session with those with radiating symptoms being seen 1.8 more visits.
Anterior ankle, corroborated by MRI and arthroscopy. These findings ing symptoms may have different lengths in episode of care but can be ex-
tive strategy to determine if conservative treatment is definitive for all
may be due to continued visits if the patient demonstrated progression
radiating upper extremity symptoms in patients with neck pain is indica-
US Army-Baylor University Doctor of Physical Therapy Program,
MANAGEMENT OF ANTEROLATERAL ANKLE IMPINGEMENT:
THE CLINICAL USE OF MUSCULOSKELETAL UL TRASOUND IN THE
CLINICAL RELEVANCE:

OP0104
THE CLINICAL USE OF MUSCULOSKELETAL ULTRASOUND IN THE
MANAGEMENT OF ANTEROLATERAL ANKLE IMPINGEMENT:
A CASE REPORT
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BACKGROUND AND PURPOSE: Sports-related ankle injuries are problematic and result in persistent pain and disability. Musculoskeletal ultrasound (MSK US) imaging can augment the clinical examination and help guide patient education and management. The purpose of this case study is to describe the clinical presentation, diagnosis and management of a female patient who underwent MSK US, physical therapy (PT) and arthroscopic ankle surgery.
CASE DESCRIPTION: The patient is a 24-year-old woman with a past history of recurrent ankle sprains who injured her ankle playing soccer where she was slide tackled and forced into end range plantar flexion. Immediately post-injury she reported to the ER where radiographs were obtained and she was placed on crutches for 2 weeks. She underwent Physical Therapy for 3 months. After completing a bout of conservative care she still had persistent and unresolved complaints of sharp anterolateral ankle pain with dorsiflexion, running, and stair descent, which did not improve de-
spite PT intervention. MSK US demonstrated an intact anterior talofibular ligament and a bony fragment on the dorsal neck of the talus, which engaged the talocalcaneal joint during dorsiflexion. This lesion was con-
firmation on MRI. Ankle arthroscopy confirmed an 8-mm bony loose body and capsular synovitis. The articular cartilage was intact without any evidence of a donor site. Dorsiflexion under arthroscopic visualization demonstrated bony impingement on the anterior distal tibia. The loose body was re-
move, and a limited synovectomy with osteoplasty of the talar neck was performed to allow full, unrestricted dorsiflexion without impingement. The patient was placed in a cam walker weight bearing as tolerated for 3 weeks and allowed to perform early full range of motion.
OUTCOMES: MSK US augmented the PT clinical exam with this patient. This provided the PT and the patient with a visualization of the loose body and capsular synovitis that contributed to her symptoms. This aid-
ed the PT in educating her and helped to adjust her return to sport and func-
tional expectations. The patient demonstrated full dorsiflexion under anesthesia after the synovitis and loose body were removed. She is currently following an uncomplicated postoperative clinical course.
DISCUSSION: MSK US in conjunction with clinical examination can aid in patient education and prognosis management with clinical conditions that may require referral and subsequent ankle surgery. The patient dem-
estrated MSK US findings consistent with an impinging lesion in the anterior ankle, corroborated by MRI and arthroscopy. These findings helped the PT educate the patient on the nature of the symptoms, the in-
bility to progress with rehabilitation, the need for further orthopaedic referral, and to better understand the prognosis for clinical management, which included both PT and orthopaedic care.
REFERENCES: 1. Croy T, Cosby N, Hertel J. Active ankle motion may re-

OP0105
THE EFFECTS OF BALANCE VERSUS STRENGTH TRAINING ON ACTIVE AND PASSIVE ANKLE POSITION SENSE IN INDIVIDUALS
WITH ANKLE INSTABILITY
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PURPOSE/HYPOTHESIS: Ankle instability is a common problem for individ-
als with a history of ankle sprains. It was suggested that altered motor control due to less accurate ankle position sense can contribute to recur-
rent injuries. The purpose of this study was to compare the training out-
come of 2 ankle rehabilitation protocols on active and passive ankle position sense.
NUMBER OF SUBJECTS: Seventeen subjects (19-30 years old) with a histo-
ry of ankle sprains volunteered for the study. Their Cumberland Ankle Instability Tool (CAIT) score ranges from 10 to 27 for the participants at the baseline testing session.
MATERIALS/METHODS: Subjects were randomly assigned to 1 of the 2 groups: (1) balance training, and (2) strength training. The supervised training lasted for 30 minutes each time, 2 times a week for 4 weeks. For balance training, exercise progressed from standing on both legs to single leg, from standing on stable surfaces to unstable surfaces, and from standing with visual feedback to standing with eyes closed. For strength training, subjects engaged resistance training for their ankle joint mus-
cles, emphasizing ankle dorsiflexors and everters. Ankle position sense was examined with the Active Reproduction of Active Positioning and Passive Reproduction of Passive Positioning protocols. A dual-axis ankle electronic goniometer was used to examine ankle angles. Two-way analy-
sis of variance with 1 between-group factor and 1 repeated-measures factor was used to analyze the data.
RESULTS: Baseline examination indicated that there is no ankle stability difference between the 2 treatment groups using their CAIT scores (F = 0.366, P > .55). For active ankle position sense, there is no difference be-
tween balance and strength training protocols (F = 0.086, P > .77), no dif-
ference among pre, post and follow-up testing (for ankle stability index (F = 1.558, P > .23), and no training-testing interaction (F = 1.026, P > .35). For passive ankle position sense, there is no difference between balance and strength training protocols (F = 0.304, P > .59), no difference among pre, post and follow-up testing (for ankle stability index (F = 3.350, P > .06), and no training-testing interaction (F = 1.172, P > .31).
CONCLUSIONS: Balance training is a common intervention for individuals with ankle instability. Results of the present investigation indicate that there is no treatment effect difference between a 4-week-long balance and strength training programs on active or passive ankle position sense. In addition, active ankle position sense has a better functional significance over passive position sense. However, neither active nor passive ankle position sense im-
improved at the completion and 1 month after the 4-week intervention.

**CLINICAL RELEVANCE:** It was reported that ankle balance training may enhance ankle proprioception and stability. However, the current study suggests that the improvement of ankle stability after training may be the result of other factors (eg, enhanced muscle/ligament strength and supraspinous control) instead of improved ankle position sense.

**OP0106**

**DOES HIP STRENGTHENING DECREASE PAIN AND INCREASE FUNCTIONAL OUTCOMES IN WOMEN WITH PATELLOFEMORAL JOINT DYSFUNCTION? A SYSTEMATIC REVIEW**

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**PURPOSE/HYPOTHESIS:** Since Title IX was signed into law in 1972, the amount of females participating in high school athletics has increased 902% and in collegiate sports 456%. With this increased activity level, there has been an increase in injury, patellarfemoral joint dysfunction, seen at the knee joint more prevalent in women. The common approach to intervention has been to focus on the knee joint itself with strengthening and taping to help with the strengthening. Recently a more global approach has been introduced incorporating proximal muscle strengthening at the hip. As this approach develops, the question arises: does hip strengthening decrease pain while increasing functional outcomes in women with patellofemoral joint dysfunction?

**NUMBER OF SUBJECTS:** Three hundred fifty-four.

**MATERIALS/METHODS:** Five exercises were chosen to search databases resulting in 260 studies identified. The number of studies after duplicates were removed resulted in 49 studies. The 49 studies were screened via title and abstract for relevance and inclusion criteria of female subjects diagnosed with patellofemoral joint dysfunction and a hip strengthening component of rehab. After reviewing, 10 studies remained. The 10 studies were reviewed in full text leading to an additional 3 studies excluded. The 7 selected studies were evaluated to determine level of research and quality of study.

**RESULTS:** All studies were considered high level design being level II randomized controlled trials. Out of the 7 studies, 3 indicated improved strength and 2 indicated decreased pain. The 2 studies that indicated decreased pain were subject to some doubt due to unclear and limited sample size. Out of the 3 studies that indicated improved strength only 1 included a hip strengthening component. The studies varied on the number and duration of interventions, and in the type of exercise intervention used. The number of interventions ranged from 1 to 16, with 50% using isokinetic strength testing as outcome measures. The studies using VAS reduced scores from average 6.4 to 1.4, a 77.7% improvement. The studies using LEFS increased scores from 53.8 to 70.3, an average of 30.6% improvement. The studies using isometric strength all showed improvement with an average increased strength of 25.9% compared to controls which decreased 4.3%.

**CONCLUSIONS:** Hip strengthening exercises should be included in the treatment of patellofemoral joint dysfunction. Closed chain exercises that include the hip and the knee should also be used during treatment.

**CLINICAL RELEVANCE:** Based upon the results of the studies reviewed, looking at the number of subjects who achieved positive outcomes with a hip strengthening component added to their treatment, it can be inferred that this approach should be added to the physical therapy protocol. Through adding a hip strengthening component to the rehab process as well as working at the knee joint itself, the patient is receiving a global treatment approach. With the patient participating in a global treatment approach to their rehab process, better outcomes can be attained by focusing interventions at more than 1 joint.

**OP0108**

**DRY NEEDLING IN THE UPPER THORAX: HAND DOMINANCE DOES NOT AFFECT THE DISTANCE TO THE LUNGS**

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**PURPOSE/HYPOTHESIS:** Dry Needling (DN) has gained popularity and its use in physical therapy is increasing. One concern associated with DN is the risk of an inadvertent piercing of the thorax pleura leading to lung collapse. It is important to understand the typical distance to the pleura and factors that will alter this distance, especially as the use of DN increases.

For example, the dominant limb may have larger muscles. The aim of this study was to present data on the distance from the skin to the lungs in 3 locations in the upper thorax, using ultrasound imaging (US) and to...
should be examined, on their influence of this distance. Caution and reference in this depth. Other factors, such as body composition, sex, age, lung pleura. Hand dominance does not appear to make a significant difference, with and without a supportive towel placed under the shoulder. ANOVA was run to determine differences between the side of dominant and nondominant hands.

RESULTS: There was no significant difference, based on hand dominance, in distance to the pleura at any of the locations assessed with or without the supportive towel under the shoulder. There was no significant difference between right or left sides of the body in young health adults.

CLINICAL RELEVANCE: Physical therapist practicing DN need to have detailed knowledge of the anatomy in the body regions they treat in order to minimize risk associated with DN, such as pneumothorax. It is important to understand the effect of various factors that may alter the distance to the lung pleura. Hand dominance does not appear to make a significant difference in this depth. Other factors, such as body composition, sex, age, should be examined, on their influence of this distance. Caution and reservation need to be exercised when DN muscles that have close approximation to the lungs.

OP010
COMPARATIVE EFFECTS OF MIRROR SQUAT EXERCISE AND HIP-STRENGTHENING EXERCISE ON PATELLOFEMORAL PAIN SYNDROME
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PURPOSE/HYPOTHESIS: Patellofemoral pain syndrome (PFPS) is a common knee-related complaint in the sporting and general populations. Although many researchers have suggested a variety of clinical intervention methods, optimal treatments for the PFPS remain unclear. The main purpose of this study was to compare recently recommended exercise methods; a mirror squat exercise (MSE) and a hip-strengthening exercise (HSE), in pain, function, kinematics, and activation onset of gluteus medius in females with PFPS.

NUMBER OF SUBJECTS: Thirty-two females with PFPS participated in this study (16 per group) and conducted 3 times per week for 12 exercise sessions over the course of 4 weeks.

MATERIALS/METHODS: This study assessed pain using the visual analogue scale (VAS), and self-reported function using lower extremity function scale (LEFS). Kinematics of lower extremity (using 3-D motion analysis) assessed hip adduction (HADD), hip internal rotation (HIR), knee adduction (KADD), and contralateral pelvic drop (CPD). Activation onset of gluteus medius was assessed using a surface EMG. The kinematics and activation onset were measured as participants performed a single-leg squat (SLS) test and a step descent test. All assessments were repeatedly measured at pretest, posttest, and 1-month and 3-month follow-ups.

RESULTS: In results of the SLS test, all kinematic variables (HADD, HIR, KADD and CPD) after 4 weeks of exercise showed significant improvement in both groups. Especially, patients assigned to the MSE group showed greater improvement and maintained it longer (up to 3 months) than those in the HSE group. In activation onset of the gluteus medius, both the MSE and HSE groups showed significantly earlier activation onset at posttest and maintained to 1 month.

CONCLUSIONS: After 4 weeks of exercises, both groups showed significant improvement in pain, function, kinematics, and activation onset. More specifically, in the SLS test, patients assigned to the MSE group showed...
greater improvement that were maintained longer (up to 3 months) than those of the HSE group. Likewise, kinematic findings in stair descent test also showed that MSE promoted greater improvement with longer maintenance (up to 1 month) than HSE. In the activation onset of the gluteus medius, both groups showed earlier activation onset at postrtest and that effects maintained to 1 month. Regarding pain and function, MSE showed superior improvement and longer maintenance (up to 1 month) than HSE.

**CLINICAL RELEVANCE:** The present study suggests that when MSE and HSE are performed for 4 weeks, MSE is more effective than HSE on pain, function, and kinematics in females with PFPS.

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**OP0111**

**SPINAL MANIPULATION INCREASES MOTOR CORTEX ACTIVITY IN HEALTHY ADULTS: PRELIMINARY RESULTS FROM AN FMRI STUDY**

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**PURPOSE/HYPOTHESIS:** Proposed mechanisms underlying the affects of spinal manipulation (SM) include biomechanical and neurophysiological changes to sensory and motor systems [1]. To date, much of the work associated with motor system change has been focused on peripheral changes or has indirectly assessed central changes. While it has been shown that SM can alter cerebral response to pain [2] and therapeutic neuroscience education can increase motor cortex activation [3], there is a paucity of data on the effects of SM on motor cortex activation. No study to date has used functional magnetic resonance imaging (fMRI) to assess changes in the motor cortex after SM. Therefore, the purpose of this study was to measure the hemodynamic changes in the motor cortex immediately after SM associated with trunk muscle activation during performance of trunk movements in the scanner. Previous work has shown that SM can increase trunk extensor muscle activation [4], therefore, we hypothesize that some of this increase was cortically driven by an increase in motor cortex activation.

**NUMBER OF SUBJECTS:** Eight.

**MATERIALS/METHODS:** Eight participants, 2 with a history of low back pain (5 females; mean ± SD age, 28.6 ± 7.2 years) performed 4 trunk movement tasks while undergoing brain functional imaging: supine bilateral and unilateral modified bridging and abdominal tightening. These tasks were chosen specifically to engage the musculature of the lumbopelvic region. A block design was utilized in which each task was performed 6 times in random order. Participants were then removed from the scanner and received bilateral side lying, rotary manipulations directed at L4-5. Trunk movements were repeated in the scanner post manipulation. T-weighted structural scans were also completed. All scans were performed on Siemens Trio 3-T MRI. FMRI data processing was carried out using FEAT (FMRI Expert Analysis Tool) with higher-level analysis in FLAME (FMRIB’s Local Analysis of Mixed Effects) [5]. A region of Interest (ROI) analysis was used to determine specific changes that occurred in the motor cortex. The ROI was generated in FSLView (FMRIB Software Library View) using the Juelich Atlas and the analysis run in FEATQuery.

**RESULTS:** The FMRI data revealed a significant increase in the blood-oxygen-level dependent (BOLD) activation in the motor cortex after SM. This increase in the BOLD activation was seen for all 4 tasks. Further exploration of specific regions within the motor cortex demonstrated that the abdominal task response was spatially different from the other tasks.

**CONCLUSIONS:** The data from this preliminary study suggests that SM may result in increased activation of the motor cortex in healthy adults with no current pain. This study lends to the evidence that SM exhibits not just a biomechanical effect to local structures but can also effects supraspinal structures.

**CLINICAL RELEVANCE:** Further understanding of the mechanisms behind spinal manipulation can assist the clinician with the integration of this technique into a comprehensive treatment plan for the patient.
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**PURPOSE/HYPOTHESIS:** Patellofemoral Pain Syndrome (PFPS) is a frequently encountered musculoskeletal disorder characterized by retropatellar knee pain that worsens with activity. The multifactorial etiology of PFPS alters lower extremity mechanics, increasing PF joint stresses during weight-bearing tasks. Kinesio (KT) and McConnell (MC) tape are often incorporated into PFPS treatment, but their efficacy is still unclear.

**PURPOSE:** To test the efficacy of KT, MC and sham taping (ST) in improving knee mechanics and reducing pain during activity. Hypothesis: KT will show better results than MC and ST, given the corrective and facilitative properties of KT.

**NUMBER OF SUBJECTS:** Ten participants (mean ± SD age, 20.3 ± 1.5 years; height, 169.9 ± 10.4 cm; weight, 70.17 ± 13.1 kg) with anterior knee pain and no history of trauma.

**MATERIALS/METHODS:** Three trials each of squat, drop jump, and step-down tasks with no tape (baseline) and under 3 taping conditions in a randomized order were performed. Two-dimensional motion analysis of lower extremities in frontal and sagittal planes was performed using 3 iPads and Sparkmotion app. RM univariate ANOVA (P<.05) compared baseline and taping conditions during exercises for pain VAS and knee flexion in all exercises, hip abduction in step-down and drop jump, frontal plane projection in step-downs and anterior knee translation in squat.

**RESULTS:** Significant reductions in VAS were recorded during squats between tapes (F_{2,40,11,69} = 3.407, P = .042). Pairwise comparison showed a mean decrease in VAS for ST (1.14, P = .008) and KT (1.54, P = .018) compared to baseline during squats. Anterior knee translation reduced with KT when compared to baseline during squats (1.92 cm, P = .048). A tendency for significance (P = .05-.10) was observed for MC with 1.7° greater reduction in hip abduction in step-down compared to KT (SE, 0.83; P = .075). ST also showed tendency to achieve 6.1° greater knee flexion compared to baseline during drop jump (SE, 2.98; P = .073). No other differences were observed (P > .11-.94).

**CONCLUSIONS:** Findings demonstrate mixed results between various taping conditions, including detectable changes with ST similar to previous reports. The effect of tape on patellofemoral pain is unclear. Sensory effects associated with short term taping may have been sufficient enough to modify knee pain by afferent input blocking nociceptive pain, before the participants could adapt. The role of KT in decreasing anterior knee translation and increasing knee flexion more than other taping during squats and drop jumps, respectively, may be due to more effective proprioceptive input or neuromuscular facilitation. Minimal changes observed in MC may be due to inferiorly shifted patella leading to increased patellofemoral contact area, allowing for improved knee mechanics.

**CLINICAL RELEVANCE:** A variety of taping methods can potentially reduce perceived pain in individuals with PFPS, allowing clinicians to target underlying pathomechanics with greater patient satisfaction. Further research is needed to examine the efficacy of patellar taping in correcting pathomechanics and serving as a placebo on perceived pain.
ure based upon the minimal clinically important difference (MCID) outcomes. Effect of exercise volume on outcomes was determined using a multivariate analysis of variance with a least significant difference (LSD) used in post hoc analyses.

RESULTS: A total of 194 records were included for QuickDASH and 202 for the NPRS scores. The between group analysis of variance for exercise group to QuickDASH change was significant (P < .001) as well as for meeting the MCID (P = .001). Post hoc analysis demonstrated QuickDASH change between the high volume group and the moderate and low volume groups were both significant (P < .001). Between group analysis of variance for group difference in NPRS change was significant (P = .013), but not for meeting the MCID (P = .469).

CONCLUSIONS: These results suggest that dosing exercise with a high volume may positively influence outcomes reported on the QuickDASH but not on the NPRS.


**OP0117**

**SUBCHONDRAL INSUFFICIENCY FRACTURE OF THE FEMORAL HEAD IN A 59-YEAR-OLD WOMAN: A CASE STUDY**

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BACKGROUND AND PURPOSE: Subchondral insufficiency fracture (SIF) occurs when normal, physiological stress is applied to weakened or nutritionally deficient bone. SIF is most often observed in the hips of osteoporotic women or renal transplant recipients. Painful hip flexion and internal rotation are the most common clinical signs, but diagnosis is made from positive MRI findings. This case study highlights the use of diagnostic imaging and clinical reasoning in the diagnosis and management of a patient with SIF of the hip.

CASE DESCRIPTION: A 59-year-old woman presented to physical therapy with constant right anterior hip and thigh pain of insidious onset. Initial objective exam findings included: markedly antalgic gait with reluctance to bear weight through the right lower extremity, need for assistance with transfers and activities of daily living, pain limited hip flexion to 45°, hip limited internal rotation to 0°, right leg 1 cm shorter than left, and positive pain provocation tests (scour, FABER, log roll). The patient had a past history of thyroid cancer. Following evaluation, the leading differential diagnosis was primary hip osteoarthritis (OA) and physical therapy treatment was initiated, consisting of gait normalization, hip range of motion, hip strengthening, and functional movement training. The physical therapist also ordered conventional radiographs to evaluate for more sinister pathology, such as fracture or metastatic cancer, due to symptom severity beyond that expected for hip OA. The patient completed the radiographs 2 weeks after the initial evaluation, which revealed severe joint space narrowing with potential for SIF, avascular necrosis of the femoral head, or blastic metastatic disease. Subsequent MRI revealed SIF of the femoral head and acetabulum, severe OA, and a degenerative tear of the labral cartilage. The patient was placed on axillary crutches, instructed on toe touch weight bearing, and referred to orthopauses for further management.

OUTCOMES: Prior to orthopaedics referral, the patient received 3 weeks of physical therapy treatment. The patient’s gait was normalized with the use of an assistive device, right hip flexion improved to 90°, and her LEFS score improved from 20/80 to 32/60 over the course of treatment. Due to persistent pain and functional limitations, the patient elected to undergo total hip arthroplasty (THA). Two weeks post THA, the patient reported 0/10 resting pain, demonstrated 120° of active hip flexion and 20° active internal rotation, had returned to work, and re-initiated outpatient physical therapy.

DISCUSSION: This case study supports that physical therapists are competent and effective in identifying and managing musculoskeletal conditions that require diagnostic imaging. The choice of diagnostic imaging was supported by patient history and clinical exam, and resulted in rapid definitive management. Furthermore, physical therapy treatment helped restore the patient’s quality of life through improved gait and hip mobility while the patient underwent imaging.

OP0118

USE OF THORACIC MANUAL THERAPY IN THE SUCCESSFUL MANAGEMENT OF A PROFESSIONAL CYCLIST WITH NEURAL MECHANOSENSITIVITY IMPAIRING POWER OUTPUT: A CASE REPORT

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BACKGROUND AND PURPOSE: Thoracolumbar pain is the most common complaint that leads professional cyclists to seek medical attention, and may lead to an inability to maintain efficient postures and generate power. Sustained thoracolumbar flexion during cycling loads the posterior spinal, neural and musculoskeletal structures potentially increasing neural mechano sensitivity (NMS). Utilization of the Thoracic Slump Test (TST), which closely mimics the cyclist’s posture, has not been studied in this population. The purpose of this case report is to describe the utilization of TST and manual therapy, specifically thoracic and hip joint mobilization and neural mobilization, in the successful management of an elite cyclist with pain, reduced power output and NMS.

CASE DESCRIPTION: A 49-year-old female professional cyclist with no significant past medical history presented to physical therapy (PT) with left anterior hip pain, left lower thoracic pain and complaint of decreased power output for 2 months during her transition from indoor to outdoor track and criterion cycling. Stretching, rest and bike component modification reproduced the concordant pain, guided the decision to use neural mobilization, in the successful management of an elite cyclist with pain, reduced power output and NMS.

OUTCOMES: She was seen in PT for 6 sessions over 8 weeks. The numeric pain-rating scale scores improved from 8/10 to 2/10, global rating of change +2 to +7, Patient Specific Functional Scale from 75 to 99, and 0/10, TKE in TST position improved from 75° to 90°, and her L hip flexion AROM improved from 120° to 140°. Power output improved from 250 W/kg to 287 W/kg.

DISCUSSION: Utilization of the TST, which mimics the cyclist’s posture and reproduced the concordant pain, guided the decision to use neural mobilization and thoracic manual therapy in the treatment. NMS may lessen force generation if the cyclist is not able to assume efficient cycling postures and achieve full TKE during the power phase of the pedal stroke. This case study suggests the potential importance of the TST in the evaluation of cyclists and the role of manual therapy in efficiently resolving thoracolumbar pain and impaired power output.

CASE DESCRIPTION: A 66-year-old woman presented reporting generalized left shoulder pain. MRI findings included a partial supraspinatus tear, acromioclavicular arthritis, and biceps tendinitis. Applying elements of the International Classification of Functioning (WHO), functional losses related to inability to play with her grandchildren and perform activities of daily living (ADLs) were noted. The Shoulder Pain and Disability Index (SPADI) initially indicated an 81% perceived disability. Physical examination focused on the left shoulder with standard movement screen followed by repeated movement testing (RMT), a key component of the MDT physical examination. Behind-the-back movements were particularly limited and painful. During RMT, the patient’s range improved with decreased pain. Repeated external rotation provoked symptoms and reduced ROM. Education for self-management included instructed on enforcing repeated movement in the direction of preference with over pressure and avoidance of provocative. Further treatments continued to emphasize repeated movements with addition of functional strengthening exercises related to her functional losses.

OUTCOMES: Abolishment of pain with ADLs and functional tasks were noted at the fifth and final visit with an improved SPADI score (5% perceived disability). Via telephone 3 weeks following discharge, the patient reported continued pain abolishment with full pain free movement. Additional follow-up was conducted 3 months after discharge with a SPADI score of 0.01%.

DISCUSSION: Despite chronicity and high pain intensity, she demonstrated significantly decreased pain and simultaneous improvement in motion, strength, and function with 5 visits. Improved SPADI scores were significantly greater than the minimal clinically important difference [8]. Actively involved in self-managing her own symptoms, this treatment approach was effective and economical. The patient’s improvement continued to be evident 3 months after discharge.

Purpose/Hypothesis: Lateral ankle sprains account for 25% of all musculoskeletal injuries, are the single most prevalent sports-related injury, and have a 70% recurrence rate [1-3]. Ankle sprains are typically treated with immobilization, leading to significant proprioceptive deficits [1]. Ankle sprains often result in chronic ankle instability due to ligamentous laxity, proprioceptive deficits, and/or functional ankle instability (FAI) “the subject’s perception that the ankle is unstable, weaker, more painful, or less functional following injury” [3]. The purpose of this study was to investigate the effects of applying variable vibrations via an external vibration-inducing device to an immobilized ankle joint after sustaining an acute ankle sprain. Vibrations are theorized to improve FAI by preventing the loss of proprioceptive input from the joint via activation of muscle spindles and mechanoreceptors typically impaired during immobilization [4]. We hypothesized that applying variable frequency and amplitude vibrations with a vibration AFO would produce significant improvements in outcome measures evaluating postimmobilization kinesthesia (Joint Position Sense [JPS]), proprioceptive input (Sensory Organization Test [SOT]), and ankle function (Motor Control Test [MCT]), Unilateral Stance (US), STAR Excursion Balance Test (SEBT), Foot and Ankle Disability Index (FADI)) as compared to standard immobilization without vibration.

Number of Subjects: Ten.

Materials/Methods: Ten subjects presenting to a university student health center with a grade II-III lateral ankle sprain were randomly allocated into 2 groups. Control subjects were immobilized with a standardized ankle foot orthosis (AFO). Experimental subjects were immobilized with a specially designed vibration AFO. Motors were placed at 5 tendons surrounding the ankle to create illusory movement [5] and controlled by a circuit board set to perform vibrations at 50 to 100 Hz for a cumulative time of 45 minutes per day. Subjects were evaluated after 7 days of immobilization by testers blinded to group assignment.

Results: Within-subject statistically significant differences were found for MCT amplitude scaling with backward translation (P = .038) and for SEBT in the postero-medial direction (P = .038). Between-subject differences were found for SOT condition 1 (P = .019) and FADI (P = .010). Statistical significance (P < .05) was not detected for the other outcome measures, although they trended in support of vibration for reduced proprioceptive loss.

Conclusions: Applying variable vibrations via an external vibration-inducing device to an immobilized ankle joint following an acute lateral ankle sprain showed limited support for preventing proprioceptive loss.

Clinical Relevance: There is some evidence suggesting that individuals receiving vibration during immobilization post ankle sprain had less proprioceptive loss. This may result in returning to previous level of function more quickly and fewer recurring ankle sprains compared to standard immobilization.

AO124

Using Measures of Center of Mass Estimated and Center of Pressure During Gait in the Design of a Rocker-Sole Modification for an Individual With Functional Ankle Mobility Limitation

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Background and Purpose: Instrumented walkway assessment can be used to allow dynamic simultaneous quantification of center of mass estimated (CoMe) and center of pressure (CoP) relationships during normal, slow, and fast gait. The purpose of this case report is to demonstrate the successful utilization of dynamic measures of CoMe with simultaneous measurement of CoP during gait in the design of shoe modification to promote ankle and forefoot rocker function in an individual with severe loss of functional sagittal plane ankle mobility.

Case Description: The patient was a 32-year-old man who suffered a TBI in a MVA with multiple lower extremity injuries including severe bilateral distal tibia and fibula fractures. At 18 months postinjury, ankle dorsiflexion remained severely limited with significant ankle joint pain. Joint mobility assessment suggested limited potential to regain functional dorsiflexion ROM. Self-selected gait velocity measured over repeated trials 0.67 m/s. Instrumented walkway analysis showed both a delay and abnormal relationship between CoMe and COP forward progression during early mid through terminal stance. Based on the CoMe and COP measures, shoe modifications were fabricated consisting of a right sole based rocker located 1 cm forwards of the anterior lateral malleolus with an approximate 5 cm radius. Additionally, moderately aggressive rigid toe spring modifications were done bilaterally.

Outcomes: Following the shoe modification and gait training, velocity of the forward progression of the COP, initially slowed during early stance, phase improved to 1.18 m/s. Forward progression velocity of the CoMe, significantly delayed initially also improved in concert with the COP progression. Simultaneously, subjective complaints of ankle pain decreased.

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progressively over the proceeding weeks leading to self-measured daily ambulation bouts of up to 3 mi. 

**DISCUSSION:** Clinical decision-making skills of a physical therapist in cases of chronic dysfunction leading to significant impairments in gait can be aided by the use of emerging technologies such as instrumented walkways. This case demonstrates the ability to utilize quantitative measures of COM and COP during gait as a potential tool to guide external shoe modification designs in an individual with chronic painful loss of ankle dorsiflexion motion limiting gait. Shoe modifications such as rocker soles, while not new to physical therapy, can be effective when designed targeting a specific gait impairment. The relationships in biomechanical measures such as COP and COM dynamics during gait do not lend themselves easily to visual observation even in the experienced therapist. This case report demonstrates the potential of using measures such as the relationship between COP and COM gathered through an instrumented walkway and hopes to stimulate future studies in individuals with gait dysfunction.

**REFERENCES:**


**OP0125**

**TELEREBHABILITATION IMPROVES QUALITY OF LIFE, REDUCES DISABILITY, AND IS ASSOCIATED WITH PATIENT SATISFACTION AFTER TOTAL KNEE ARTHROPLASTY: A SYSTEMATIC REVIEW OF THE LITERATURE**

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**PURPOSE/HYPOTHESIS:** Total knee arthroplasty (TKA) is a common surgery requiring postsurgical rehabilitation to improve outcomes in function. Telerhabilitation is a feasible alternative approach to face-to-face outpatient and home care in delivering health care services in rural settings where demand is high and access is limited. The benefits of telerhabilitation in TKA have been less thoroughly analyzed. The purpose of this review is to compare conventional face-to-face therapy and telerhabilitation in terms of therapeutic outcomes, patient satisfaction, and cost-effectiveness for post-TKA patients.

**NUMBER OF SUBJECTS:** Six studies were included in this systematic literature review.

**MATERIALS/METHODS:** Four electronic databases were searched: Cochrane Library, Ovid MEDLINE, CINAHL, and PEDro. Studies were considered for inclusion if physical therapy was implemented via telerhabilitation for postoperative TKA patients. Outcomes had to address therapeutic outcomes, patient satisfaction, or cost effectiveness. Two reviewers extracted study and participant characteristics. Quality and level of evidence were assessed using the PEDro scale and OCEBM levels of evidence. Action statements were generated and assigned an OCEBM grade of recommendation.

**RESULTS:** The review included 6 RCTs providing 731 participants. There was Grade B evidence for action statements related to improving quality of life, reducing disability, and maintaining patient satisfaction. Improving functional activity was also supported by grade B evidence, however, based on a preponderance rather than consistent evidence. Due to insufficient evidence pertaining to cost-effectiveness we were unable to form an action statement.

**CONCLUSIONS:** This review identified moderate evidence to support that telerhabilitation can be as effective as conventional face-to-face therapy in improving quality of life, reducing disability, and maintaining patient satisfaction post TKA. There is conflicting evidence that telerhabilitation is effective in improving functional activity, though supporting evidence outweighs refuting evidence. Despite a lack of supporting studies, cost analyses demonstrated telerhabilitation might be a cost-effective alternative to conventional therapy, although further research on economic costing is required.

**CLINICAL RELEVANCE:** Although face-to-face care may be necessary on some occasions for particular patients, the results of this review strongly suggest that in-home telerhabilitation could be used to improve accessibility of health care services in rural, remote communities and dense urban locations where high volume, waiting times, and cost of services are major barriers to people who have undergone a TKA procedure.

**OP0126**

**DOES SLEEP QUALITY MODERATE THE RELATIONSHIP BETWEEN PAIN INTENSITY AND HEALTH CARE UTILIZATION? LONGITUDINAL ANALYSIS FROM A COHORT OF PATIENTS WITH LOW BACK PAIN**

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PURPOSE/HYPOTHESIS: Pain intensity in patients with back pain is associated with pain related disability and health care utilization. It is also known that these patients have comorbidities that can influence factors like disability and the back pain related health care utilization. One of these comorbidities is sleep quality. The purpose of this study was to evaluate the relationship between perceptions of daytime sleepiness and patients seeking continued care for back pain. Specifically, we wanted to determine whether sleepiness was able to moderate the relationship between pain and health care utilization, and disability and health care utilization.

NUMBER OF SUBJECTS: Seven hundred fifty-eight patients referred to self-management education class for low back pain in the physical therapy clinic at Madigan Army Medical Center, Tacoma, WA, between March 1, 2010 and December 4, 2012.

MATERIALS/METHODS: Participants completed self-reported measures of pain intensity, disability (Oswestry Disability Index), and sleepiness (Epworth Sleepiness Scale). Healthcare utilization was extracted from the Military Health System Data Repository (MDR) for a 24-month period (12 months before and after the self-management class). Total number of lumbar spine-related medical visits was abstracted for the 1-year period after the class based on relevant International Classification of Diseases, Ninth Edition (ICD-9) codes. Total number of comorbidities over the 24-month period was also collected for each subject. The association between pain intensity and health care utilization (medical visits) was investigated using multivariate Poisson regression analyses, adjusted for previous history of back pain, and the total number of comorbidities. To examine the moderating effect of sleepiness, we tested its interaction with pain intensity. These analyses were repeated with disability as the outcome, using multivariate linear regression.

RESULTS: Pain intensity levels were associated with the total number of medical visits (IRR = 1.11; 95% CI: 1.09, 1.13; P < .01) and disability ratings (IRR = 1.03; 95% CI: 1.02, 1.03; P < .01). Sleepiness significantly moderated the relationship between disability rating and the number medical visits (IRR = 0.99; 95% CI: 0.99, 1.01; P < .01), but did not moderate the relationship between pain intensity and medical visits (IRR = 0.99; 95% CI: −0.99, 1.00; P = .40).

CONCLUSIONS: Higher pain intensity and disability were associated with greater 1-year LBP-related health care utilization. The presence of sleepiness increased the amount of LBP-related health care utilization in patients with higher disability, but not in patients with higher pain intensity.

CLINICAL RELEVANCE: Assessing and addressing sleepiness in patients with low back pain has the potential to assist clinicians in their interpretation of how disability will impact long-term health care utilization.

OP0127

THE IMMEDIATE EFFECTS OF THORACIC SPINE MANIPULATION VERSUS A SHAM COMPARATOR ON THE UPPER-LIMB PROVOCATION TEST AND SEATED SLUMP TEST

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PURPOSE/HYPOTHESIS: Previous research suggests that mechanical and neurophysiologic mechanisms may be responsible for the clinical benefits of manipulation. While studies indicate remote and peripheral improvements in pain, range of motion, and motor function following manipulation, no studies have investigated the effects of a supine thoracic spine manipulation (TSM) on neurodynamic mobility, as compared to a sham intervention. This study aimed to determine the immediate effects of TSM on the Upper Limb Provocation Test (ULPT) and Seated Slump Test (SST) compared to a sham intervention in asymptomatic subjects with neurodynamic limitations.

NUMBER OF SUBJECTS: Forty-eight (130 limbs).

MATERIALS/METHODS: Forty-eight adults were randomized into 2 groups, TSM or a sham intervention (TSM procedure without a thrust), and tested for the presence of neurodynamic limitations via the ULPT and SST. Those who met previously published range of motion limitations (n = 43) for at least 1 of the 4 limbs measured received their preassigned intervention (TSM, n = 22; sham, n = 21). Neurodynamic mobility was reassessed after intervention. Subjects were questioned preintervention and postintervention regarding perceived effect and to determine believability of the sham manipulation.

RESULTS: Forty-three subjects (60 UR and 70 LE) demonstrated positive neurodynamic testing. Separate 2-by-2 repeated-measures analyses of variance were used to examine the effects of intervention (TSM, sham) and time (preintervention, postintervention) on ULPT and SST measurements. Both the ULPT (F1,49 = 42.56, P < .001) and SST (F1,59 = 20.50, P < .001) demonstrated improvements at posttest regardless of intervention received. ULPT effect size for both TSM (d = 0.75) and sham (d = 0.79) groups were medium. However, for the SST, the effect size for the TSM group (d = 0.66) was medium, while the sham group (d = 0.22) was small. No significant differences were noted for believability of the intervention received (η2 = 0.37, P = .44) or for perception of effect between groups pretreatment (η2 = 0.83, P = .24) and posttreatment (η2 = 2.71, P = .61).

CONCLUSIONS: These findings indicate that peripheral neurodynamic mobility improved in both the upper and lower quarter regardless of intervention. The magnitude of change in lower quarter neurodynamic mobility following TSM further supports a neurophysiologic mechanism of manipulation. In addition to proposed neurophysiologic effects supported by previous research, the remaining findings highlight nonspecific effects such as therapeutic alliance and patient expectation that may impact the clinical benefit of manipulation. The sham utilized in this study demonstrated adequacy as a sham comparator to a supine TSM.

CLINICAL RELEVANCE: While thoracic spine manipulation has been correlated with improvements in local and peripheral impairments, assessment of patient expectations and beliefs may assist therapists in technique selection if improvement in peripheral neurodynamic mobility is sought.

OP0128

INTERRATER AND INTRARATER RELIABILITY OF A CORE STABILITY PERFORMANCE TEST

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PURPOSE/HYPOTHESIS: The supine double leg lowering test (SDLTT) as initially described by Kendall has been previously reported in the literature as a reliable measure of core activation and stability during lower extremity movement [1]. However, there is wide variability in the execution and measurement of the SDLTT. The purpose of this study was to define a standard method of implementing the SDLTT and to investigate the inter and intrarater reliability of this method. It was hypothesized that examiners would demonstrate moderate to good inter and intrarater reliability in their measurement of the SDLTT.

NUMBER OF SUBJECTS: Ten healthy subjects (mean ± SD age, 22.5 ± 1.6 years; 6 female, 4 male).

MATERIALS/METHODS: Two licensed physical therapists measured and recorded data for ten subjects who performed 4 trials of the SDLTT with a 1-minute break between each. The physical therapists were trained in performing and measuring the SDLTT using a protocol developed using previous research published in the literature [2,3]. A stabilizer, which was placed under the subject’s lumbar spine, was used to monitor the end of the test. At this end point, 1 examiner used a single inclinometer to record performance in degrees from horizontal. Specific methodology was utilized to eliminate the potential for intrarater bias while measuring the...
test. Intrarater agreement was calculated using intraclass correlation coefficients and Pearson correlation was used to assess interrater reliability.

**RESULTS:** Intraclass correlation coefficients assessing the intrarater reliability of the SDLLT in a population of young, healthy subjects suggests this is a highly reliable method to assess core activation and stability (0.885, P < .001). Interrater reliability using this methodology was also highly reliable (0.832, P = .001).

**CONCLUSIONS:** These findings are consistent with the hypothesis that the SDLLT method described has high inter and intrarater reliability when assessing core stability and activation.

**CLINICAL RELEVANCE:** It is necessary to utilize a reliable test to assess core stability and activation during physical therapy evaluation and treatment. Previously, researchers have described a subgroup of patients who would benefit from core stabilization in the treatment of low back pain and a clinical prediction rule has been developed for this subset of patients [4,5,6]. Currently no gold standard for measuring this impairment has been described in the literature and there is inconsistency in how the SDLLT is performed [2,7]. This study demonstrates that the defined standardized method of measuring the SDLLT has good inter and intrarater reliability and can be used to assess core stability. This study prepares the foundation for future planned studies to establish normative values for the SDLLT in the pediatric population.

**REFERENCES:**

Op0131

TREATMENT OF CERVICODGENIC HEADACHE IN AN ADULT PATIENT USING THERAPEUTIC EXERCISES FOR CORRECTION OF MOVEMENT IMPAIRMENTS: A CASE REPORT

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BACKGROUND AND PURPOSE: Tension HA, cervicogenic HA, and migraine are the most prevalent types of HA among adults [1]. The prevalence of cervicogenic HA is estimated at 0.5% to 4% of the general population, but may be as high as 20% of points presenting with severe chronic HA [2,3,4]. A common postural impairment noted in this population is a forward head position with increased upper cervical extension [5]. This position, when sustained or habitually repeated, produces increased stress on the cervical facet joints and is likely a contributing factor in cervicogenic HA or cervicalgia [5,6,7]. The purpose of this case report is to describe evaluation and treatment of neck pain with tension HA and migraines. It will describe how education in proper postural alignment and therapeutic exercise can address impairments of the cervical and scapular regions to abolish cervicogenic HA symptoms.

CASE DESCRIPTION: The patient was a 42-year-old woman with a medical diagnosis of “cervicalgia.” She worked from home 5 days a week and spent most of her time on a computer. She reported her migraines began at 14 years old. She also reported experiencing tension-HA, that would last for multiple days. She reported 4 d/mo symptom-free. At evaluation, she had decreased HA intensity to 0/10 by the sixth visit and neck pain to 0/10 by the seventh visit. Additionally, her postural control and awareness had improved at the conclusion of treatment and neck pain to 0/10 by the seventh visit. Additionally, her postural control and awareness had improved at the conclusion of treatment and neck pain to 0/10.

OUTCOMES: The patient had decreased HA intensity to 0/10 by the sixth visit and neck pain to 0/10 by the seventh visit. Additionally, her postural control and awareness had improved at the conclusion of treatment and she reported decreased reliance on medication.

DISCUSSION: The result of this case report suggest that therapeutic exercises focused on correcting posture and movement faults during ADLs can be helpful in reducing the symptoms associated with cervicogenic HA.


Op0132

RELATIONSHIP BETWEEN THE FUNCTIONAL MOVEMENT SCREEN, HOP TEST, AND OTHER PERFORMANCE-RELATED PARAMETERS IN HIGH SCHOOL BASKETBALL PLAYERS

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PURPOSE/HYPOTHESIS: The Functional Movement Screen (FMS) has been shown to reliably assess an athlete’s risk of injury. Recent research has suggested that the Hop Test may also be able to assess asymmetry and risk of injury. However, there is little evidence correlating FMS scores to the Hop Test. Additionally, there is very little research relating scores from either assessment to athletic performance, specifically in basketball. This study aims to determine if there is a correlation between the FMS, Hop Test, and the NBA Draft Combine testing battery.

NUMBER OF SUBJECTS: Twenty-five.

MATERIALS AND METHODS: Twenty-five participants selected from a high school basketball program were evaluated using the FMS, Hop Test, and selected tests adapted from the NBA Draft Combine. Data collected from these test batteries was then analyzed for significant correlations using either a Pearson or Spearman correlation statistic as appropriate.

RESULTS: Pearson correlations for the data demonstrate statistically significant relationships between the FMS and certain NBA Combine tests including the box drill and on the move shooting drill (r = 0.45 and 0.42, respectively). Right sided FMS scores were correlated with right sided single-leg timed hop and triple hops (r = 0.49 and 0.41, respectively). Left sided FMS scores were correlated with the single-leg timed hop, triple hop, and crossover hop (r = 0.63, 0.63, and 0.59, respectively). Individual components of the hop test were also correlated in some extent to nearly all individual tests from the NBA Combine. Notable correlations were found between triple hop to standing vertical, max vertical, box drill, three-quarter-court sprint, and reactive shuttle drill (for right side: r = 0.60, 0.75, –0.74, –0.77, –0.62; for left side: r = 0.56, 0.70, –0.61, –0.78, –0.53, respectively) and between the single-leg timed hop and standing vertical, max vertical, box drill, three-quarter-court sprint, and reactive shuttle drill (for right side: r = 0.42, –0.63, 0.55, 0.66, 0.54; for left side: r = 0.45, –0.62, 0.58, 0.66, 0.48, respectively).

CONCLUSIONS: These findings appear to support the hypothesis that components of the FMS, Hop Test, and NBA Combine Hop Test are correlated with performance ability. Additionally, these correlations may indicate that the Hop Test is a tool that may potentially be utilized to determine an athlete’s risk of injury. More studies are needed to further examine the Hop Test as a reliable assessment of an athlete’s risk of injury and also to address the link between the FMS and Hop Test as predictors of athletic performance.

CLINICAL RELEVANCE: Correlating the FMS to athletic ability would allow clinicians in the field of sports performance to quickly and efficiently target deficits to improve skill. The Hop Test may also be a reliable addition, or substitution, for the FMS in preseason physical screenings.
**OP0133**

**BODY FUNCTIONS, ACTIVITY LIMITATIONS, AND PARTICIPATION RESTRICTIONS IN PATIENTS WITH CHRONIC LOW BACK PAIN WHO CHOOSE TO UNDERGO LUMBAR SPINE SURGERY**

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**PURPOSE/HYPOTHESIS:** Despite large variation in recommendations and quality of surgery-related clinical guidelines, approximately 3.2 million patients underwent low back surgery in the US in 2010 [1]. A shift toward a patient-centric ‘personalized’ approach to management encourages clinicians to account for individual characteristics of each patient [2]. No classification system currently directs the choice of surgical treatment [3,4]. Using the International Classification of Functioning, Disability and Health (ICF) Framework [5], the purpose of this study was to comprehensively describe the body function, activities, and participation levels of patients who choose to go through lumbar decompression or fusion surgery.

**NUMBER OF SUBJECTS:** Twenty-five adults (8 female, 17 male) with chronic low back pain who were recommended for lumbar spine surgery and chose to go through one were tested prior to their surgery.

**MATERIALS/METHODS:** Each patient went through a quick but comprehensive battery of self-reported and functional tests. Questionnaires included the Oswestry Disability Index (ODI), Roland-Morris Disability Questionnaire (RMQ), Physical Activity Subscale of the Fear-Avoidance Beliefs Questionnaire (PA-FARQ), International Physical Activity Questionnaire (IPAQ), and numeric pain-rating scale (NPRS). Clinical measures included the 400-m walk test (400MWT), 8-ft timed up-and-go (TUG), Four Square Step Test (FSST), 30-second sit-to-stand test, Single-Leg Balance Test, Chair Sit and Reach Test, passive straight leg raise (PSLR), and single-leg heel rise (SLHR) test. Descriptive statistics for presurgical questionnaires and clinical measures were performed.

**RESULTS:** Patients self-reported a minimum of 20 (minimal disability) to a maximum of 76 (crippling back pain) on the ODI; a minimum of 1 to a maximum of 21 on the RMQ; 0 to 10 for back or leg pain on the NPRS; and “not active” to “highly active” on the IPAQ with 150 minutes of walking per week. The minimum to maximum on the PA-FARQ was 6 to 24. Eight patients completed the 400MWT in less than 5 minutes, 8 patients could not complete the test. The minimum to maximum on the TUG was 3.66 to 17.81 seconds and on the FSST was 4.56 to 23.2 seconds. The number of sit-to-stands performed in 30 seconds ranged between 2 and 29. Balance on a single leg was held between 0 to 30 seconds. Chair sit and reach ranged between –30 and +30 cm. PSLR ranged between 35° to 115° with 0 to 10 pain reported in either the back or the leg. The number of SLHR completed out of 20 ranged between 0 and 20.

**CONCLUSIONS:** Results of body function, activity, and participation-level measures for these patients were from one end of the spectrum to the other. No single test demonstrated the ability to indicate the surgical need for all individuals tested. These patients will be followed up after surgery to see if any of the measures correlate with surgical outcomes.

**CLINICAL RELEVANCE:** A comprehensive battery of measures at all ICF levels presurgery, may shed light on patients’ postsurgical outcomes.

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**OP0135**

**INDIVIDUALS WITH LUMBAR SPINAL STENOSIS DESIRE EMPATHETIC CARE FOCUSED ON SELF-MANAGEMENT: RESULTS OF FOCUS GROUPS WITH RCT PARTICIPANTS**

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**PURPOSE/HYPOTHESIS:** To determine the test-retest reliability and estimate the minimal detectable change (MDC) score of the NIH’s PROMIS Pain Interference (PI) and Physical Function (PF) CATs in individuals with knee osteoarthritis (OA). We hypothesized that the CATs would demonstrate good test-retest reliability over clinically relevant time frames in individuals who report no change in status.

**NUMBER OF SUBJECTS:** Thirty-two individuals with knee OA (mean ± SD age, 62.0 ± 11 years old; 56% female) participated in up to 4 data collec-

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**OP0139**

**TEST-RETEST RELIABILITY AND MINIMAL DETECTABLE CHANGE OF THE PATIENT-REPORTED OUTCOME MEASUREMENT INFORMATION SYSTEM PHYSICAL FUNCTION AND PAIN INTERFERENCE COMPUTER ADAPTIVE TESTS IN INDIVIDUALS WITH KNEE OA**

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**PURPOSE/HYPOTHESIS:** To determine the test-retest reliability and estimate the minimal detectable change (MDC) score of the NIH’s PROMIS Pain Interference (PI) and Physical Function (PF) CATs in individuals with knee osteoarthritis (OA). We hypothesized that the CATs would demonstrate good test-retest reliability over clinically relevant time frames in individuals who report no change in status.

**NUMBER OF SUBJECTS:** Thirty-two individuals with knee OA (mean ± SD age, 62.0 ± 11 years old; 56% female) participated in up to 4 data collec-

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**OP0137**

**CLINICAL RELEVANCE:** Clinicians should provide information about the disease process and techniques for self-management in an empathetic manner. This will improve the likelihood that individuals with LSS have a positive response to treatment. Individuals with LSS will seek empathetic care from nontraditional sources if they feel that traditional medical providers are not providing appropriate or compassionate care.
MATERIALS/METHODS: Participants were asked to complete the PROMIS PF and PI CATs at a baseline session, and at follow-ups of 1, 3, and 6 months. Participants answered a 15 point global rating of change (GRC) question at each follow-up. We operationally defined a participant to be stable if they responded that they were “hardly any worse at all” (−1), “about the same” (0), or “hardly any better at all” (1) on the GRC. Scores outside of this range were categorized as not stable. We compared the follow-up CAT scores to the baseline CAT scores for each cohort of stable participants and summarized change scores. Test-retest reliability was assessed with a 2-way Random Effects Intraclass Correlation Coefficient for absolute agreement of single measures (ICC model 2,1). We operationally defined an ICC2,1 of 0.75 to indicate good test-retest reliability. Based on the ICC2,1, an MDC was calculated.

RESULTS: Follow-up was obtained from 27 participants at 1 m (84%), 30 participants at 3 m (94%) and 28 participants at 6 m (88%). On average, participants completed the PF CATs in 4.1 items (range, 4-6 items) and PI CATs in 5.5 items (range, 4-13 items). For the PROMIS PF CAT, average change scores were all less than 1.5 points and all ICC2,1 values were greater than 0.8, but tended to decrease over time. MDC values were 8 points at 1 m, 7.4 points at 3 m, and 5.7 points at 6 m, with higher limits of the 95% of confidence intervals less than 12.3 points. PROMIS PI CAT scores were not reliable over time (ICCs ranged from 0.56 to 0.69), and point estimates of the ICC were not precise as indicated by the wide confidence intervals (eg, 1 m; ICC2,1 95% CI: 0.04, 0.84 points). Poor reliability led to large MDC values (33.8-17.9 points).

CONCLUSIONS: The PROMIS PF CAT is a reliable and efficient measure in individuals with knee OA over periods of 1, 3, and 6 months. Depending on the time frame, changes less than 8 points may be attributed to measurement error, and changes greater than 12 points would be considered a true change in physical function. The PROMIS PI CAT is not a reliable measure in individuals with knee OA, potentially due to the variable nature of pain with OA.

CLINICAL RELEVANCE: The PROMIS PF CAT can be used with individuals with knee OA over time, with changes greater than 8 points likely indicating a change beyond measurement error. Future work to establish PF CAT responsiveness and minimal clinically important differences is needed.
CONCLUSIONS: There were no biomechanical benefits of wearing the brace for 6 weeks, but individuals in the Brace group did demonstrate a significant and important reduction in the worst pain outcome. This may indicate that wearing the brace was able to reduce painful flares in the experimental group. Both groups improved over time for the stair climbing test and the “best knee pain.” These improvements may be attributed to the stretching protocol that was identical in each group. The duration of wear was only 6 weeks and most previous research has evaluated biomechanical and functional outcomes over a longer period of wear time. The shorter time between the testing sessions may contribute to the lack of difference between groups.

CLINICAL RELEVANCE: This unloader brace is a promising noninvasive treatment option for patients with osteoarthritis who experience high levels of knee pain.

OP0138

NOVEL REHABILITATION PROTOCOL TO RETURN PATIENTS TO HIGH-LEVEL ACTIVITIES, SPORTS, AND OCCUPATIONS AFTER TOTAL HIP ARTHROPLASTY

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PURPOSE/HYPOTHESIS: Individuals undergoing total hip arthroplasties (THA) are getting progressively younger. Although the surgical techniques and biomaterials have improved, rehabilitation has not kept pace with the goals and expectations of this younger patient demographic. The purpose of this study was to evaluate the feasibility and effectiveness of a treatment intervention protocol that included progressive strengthening and high-level activity retraining.

NUMBER OF SUBJECTS: Seven subjects completed this ongoing clinical study; 3 subjects in the control group (age range, 58-70 years; 2 female, 1 male) and 4 in the experimental group (age range, 53-70 years; 1 female, 3 male).

MATERIALS/METHODS: The experimental intervention was novel with respect to timing and content. The experimental group received 16 sessions over 16 weeks. Subjects were seen once every 2 weeks for the first 12 weeks, followed by 3 times a week for 4 weeks. Training was tailored to individual patient goals, but included a comprehensive and progressive home exercise program, biofeedback to promote movement symmetry, progressive strengthening and high level activities in the later stage. The control group received usual care and the timing and content of rehabilitation was not constrained. Testing included 3-D gait analysis (Vicon Motion Systems Ltd, Oxford, UK) and functional and clinical measures (Timed Up and Go, Stair Climbing Test, and 10-point pain scores). Change scores for each group were calculated and compared using independent t tests. Biomechanical variables included peak vertical ground reaction force (vGRF), peak hip adduction angle, and external peak hip adduction moment.

RESULTS: The experimental group had a 9.35% increase in peak vGRF compared to a 0.37% increase in the control group (P = .04). Hip adduction increased 4.58° in the control group, whereas the experimental group increased 1.99° (P = .122). There was a 10.26% increase in the hip adduction moment in the experimental group, while the control increased 4.26% (P = .720). Hip pain decreased 3.5 points in the experimental group, but there was no reduction in pain in the control group (P = .009). Both groups improved in the Timed Up and Go. The experimental group had substantial improvement in stair climbing time (8.4 seconds) compared to the control group (1.15 seconds) (P = .472). Similarly, the experimental group increased Six-Minute Walk Distance by 147.1 m, while the control increased 39.6 m (P = .138).

CONCLUSIONS: This novel treatment protocol is feasible in a clinical setting and had a positive impact on function and hip biomechanics. The experimental group had improved joint kinetics and dynamic improvements in performance by 16 weeks. Differences between groups were fairly large and the lack of significance is likely attributed to the low sample size of this preliminary analysis.

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

OP0139

TREATMENT OF UNILATERAL SCAPULAR DYSKINESIS AND PAIN IN A HEALTHY, ACTIVE ADULT: A CASE STUDY

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BACKGROUND AND PURPOSE: The purpose of this study was to discuss treatment of a healthy, high functioning adult with scapular pain. It was hypothesized that in the absence of strength, muscular endurance, ROM, and glenohumeral joint mobility deficits, improving scapular control through neuromuscular re-education alone would effectively restore scapular positioning and normal scapular rhythm, thereby reducing pain and functional limitations.

CASE DESCRIPTION: The subject was evaluated with complaints of fluctuating scapular pain that hindered his ability to sleep, exercise, and perform his usual work duties. Upon examination, he was found to have no muscle endurance, ROM, or glenohumeral joint mobility deficits, and minimal strength deficits. Upon visual inspection of his scapula, the patient was found to have an obvious scapular dyskinesis of his involved scapula when weight bearing through the upper extremities. An attempt was made to objectify this asymmetry using the lateral scapular slide test (LSST). This scapular dyskinesis was used as the basis for treatment, which included verbal and tactile cuing for scapular movement quality as well as neuromuscular re-education for scapular stability and control.

OUTCOMES: The patient was seen in the clinic for a total of 14 visits. The QuickDash and ND1 outcome measures improved from 13.6% and 12%, respectively, to 0% at discharge. Objective measures were taken once weekly, except for the LSST, which was performed pretreatment and post-treatment at each therapy visit; however, there are visits where the LSST was not performed due to clinical constraints. The patient’s initial pain of 1 to 4/10 at initial visit was resolved by discharge. At the initial visit, manual muscle testing of the middle scapula, lower scapula, and shoulder external rotation revealed minimal strength deficits, which improved slightly by discharge. The differences in the right and left scapular positions varied by as much as 2.5 cm with the LSST, but trended toward improvement and were symmetrical at discharge. The patient reported full return to his prior level of function without restriction at discharge.

DISCUSSION: The results of the LSST showed a consistent trend toward improvement in scapular symmetry, both within therapy sessions and between therapy sessions. However, the LSST has poor reliability, specificity, and sensitivity, and obvious scapular dyskinesis in weight bearing was visualized throughout treatment to discharge. This not only reinforces the need for further research into development of a valid and reliable objective measure for scapular dyskinesis, but also raises the question of how one can improve pain and function without changing the position of the scapula in functional positions. In this case scenario, it is hypothesized that the patient’s resolution of pain and full return to prior level of function was due to neuromuscular re-education of the scapulothoracic musculature resulting in improved control throughout the movement pattern rather than improved positioning of the scapula.

OP0140
IN VIVO ULTRASOUND OF RADIAL-HEAD MOTION AND EFFECT OF MOBILIZATION DIRECTION ON FOREARM RANGE OF MOTION
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PURPOSE/HYPOTHESIS: Describe the motion of the radial head during forearm pronation and supination using real-time ultrasound (US) imaging and determine the immediate effects of joint mobilization.

NUMBER OF SUBJECTS: Forty-three subjects (32 female, 11 male; mean age, 29 years) with normal upper extremity (UE) range of motion.

MATERIALS/METHODS: The experimental UE was randomly selected and assessed in full elbow extension and 90° of elbow flexion. An adjustable height table was used to standardize positioning while the glenohumeral joint was stabilized. Subjects performed pronation and supination from neutral synchronized to a metronome at 60 bpm. Ultrasound (US) cineloops were recorded using a linear transducer oriented in the transverse plane over the radial head. Subjects were then randomized to receive an anterior or posterior radial head mobilization the rate of which was standardized at 2 Hz (120 bpm) with a metronome. Range of motion (ROM) measurements were taken pre-mobilization and post-mobilization.

RESULTS: US showed the radial head rolled in an anteromedial direction during pronation and a posterolateral direction during supination. No translation was evident on US imaging in the transverse plane. Multivariate analysis revealed significant interaction effects (P = 0.02; power, 0.66) between direction of mobilization and ROM and elbow position and ROM (P = 0.03; power, 0.80). Post hoc ROM analysis revealed anterior mobilization significantly increased passive pronation (P = 0.040) while significantly decreasing active supination (P = 0.045) when assessed in full extension but significantly increased active supination (P = 0.037) when assessed in 90° of flexion. Posterior mobilization significantly increased ROM for active supination (P = 0.028) while significantly decreasing passive pronation (P = 0.044) in 90° of flexion.

CONCLUSIONS: Studies have reported translatory motion of the radius that contrasts with that opined by the convex-concave rule which therapists frequently use to determine the direction of joint mobilization. Our findings appear to support previous findings which question the application of the convex-concave rule, albeit we did not note any translation which may be a consequence of imaging in 1 plane and the magnitude of translation. Neumann has postulated that the rule is not flawed but misrepresented as it was not intended for use to enhance joint motion but merely to describe physiological joint motion. The motion in pathological joints may be different. Should we now reconsider application of the convex-concave rule as a means of improving joint motion or just mobilize based on where the restrictions are?

CLINICAL RELEVANCE: Elbow trauma often leads to deficits in PRUJ motion which can be difficult to treat given the complexity of the joints involved. This study is in agreement with others which have reported inconsistencies which are paradoxical to the convex-concave rule. Further study is required to determine if current mobilizations are efficacious and if the technique should be changed given recent findings.

OP0141
DETERMINING CONTRIBUTING FACTORS TO OUTCOME MEASURE SCORES USING TRIAXIAL WEARABLE SENSOR TECHNOLOGY IN AN INDIVIDUAL USING A STRAIGHT CANE AND ANKLE-FOOT ORTHOSES
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BACKGROUND AND PURPOSE: There is a strong association between gait, increased energy expenditure (EE), and risk for falling. The timed up and Go (TUG) and 6 minute walk test (6MWT) are frequently used to determine fall risk by means of a single score. Additionally, sharp turns, as involved in TUG and 6MWT, suggest quality of turns, and not only distance walked, can increase EE. This report compared temporospacial components of gait and EE in an individual using assistive devices over 3 different time points during the TUG and 6MWT.

CASE DESCRIPTION: The subject was a 44-year-old woman who developed a dropped foot following a L4-S1 fusion. Prior to surgery, she was an active individual and a former gymnast. She presented with diminished patellar and Achilles reflexes of 1/4 and 2/4 respectively, and diminished sensation of the left lower extremity (LE). MMT for her LLE was: hip flexion 4/5; knee extension 4/5; tibialis anterior 1/5; extensor hallucis longus 1/5 and heel raises 3/5. She ambulated with a straight cane and a customized ankle-foot orthosis (AFO). Data were collected at 3 time points separated by at least 1 week. However, on return for the second session she related that she had a fall at home several days previously.

OUTCOMES: The subject used her AFO for session 1, while she used her cane and AFO for sessions 2 to 3. A Kinesis QIUG wireless system was used to acquire temporospatial parameters. Energy expenditure (EE) was assessed using the energy expenditure index (EEI) and the Borg scale of perceived exertion. Times to complete the TUG were 7.7, 9.1, and 7.3 seconds and velocity was 0.78, 0.66 and 0.82 m/sec for sessions 1 to 3, respectively. Velocity decreased approximately 18% while cadence (24%) and stance time (20%) decreased from session 1 to session 2. 6MWT EEI for sessions 1 to 3 was 0.64, 0.28 and 0.34 beats/min, while velocity was 1.78, 1.4 and 1.75 m/sec and distance (6MWD) covered was 653, 520 and 632 m, respectively. 6MWT velocity was approximately 50% faster than the TUG, while cadence for the 6MWT versus TUG differed (mean, 127 versus 115.9 steps/min) across all sessions with average stride length remaining consistent. Surprisingly, turning efficiency was not affected by the fall. EEI correlated with 6MWD (r = 0.72), Borg score (r = 1), and gait velocity (r = 0.54). By session 3 most parameters had returned to at least prefall levels.

DISCUSSION: The availability of portable wireless technology provides a plethora of real-time data that is not readily apparent from the TUG and 6MWT. This case report showed the impact of a fall was apparent from TUG and 6MWT scores. However, the value in being able to quantify biomechanical inefficiencies contributing to such scores using the QIUG could lead to targeted interventions to specific components which are readily identifiable. Moreover, such a device can provide objective information on patient response to treatment and could result in considerable time cost savings with regard to productivity and outcomes assessment...


OP0142
EFFECTIVE ELECTRONIC BEHAVIOR MODIFICATION TOOL FOR SEATED POSTURE
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Physical Therapy, University of Texas Health Science Center San...
**Combined Sections Meeting**

**OPO143**

**THE ASSOCIATION OF THE FUNCTIONAL MOVEMENT SCREEN AND SINGLE-LEG HOP TESTS WITH MUSCULOSKELETAL INJURY IN FIREFIGHTER RECRUTS**

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**PURPOSE/HYPOTHESIS:** The purpose of this study was to determine if the Functional Movement Screen (FMS) total score of 14 or less and/or single-leg hop tests were associated with musculoskeletal injury in firefighter recruits. It was hypothesized that both an FMS total score of 14 or less and lower single-leg hop test scores would be associated with musculoskeletal injury in firefighter recruits.

**NUMBER OF SUBJECTS:** Data from 60 firefighter recruits (59 male) were analyzed for this study.

**MATERIALS/METHODS:** A retrospective chart review was performed to determine the relationship between the FMS total score and musculoskeletal injury, and single-leg hop tests and musculoskeletal injury. All recruits were scored on the FMS at the beginning of a fire academy. All recruits completed 4 single-leg hop tests at the beginning of the fire academy: single-leg hop test, triple hop test, crossover hop test, and 6-m hop test. The criterion used to define musculoskeletal injury was that the recruit was referred to occupational health during the fire academy. Descriptive statistics were calculated for the sample and for the FMS and single-leg hop tests data. To determine if there was a significant difference between the FMS total score of injured recruits and uninjured recruits a Mann-Whitney U test was performed. A crosstabulation table was used to calculate the relative risk of injury with a FMS total score of 14 or less. The Mann-Whitney U test was used to identify significant differences between injured and uninjured recruit single-leg hop test scores.

**RESULTS:** Fifteen percent of the recruits (n = 60) had a musculoskeletal injury during the fire academy. There was not a significant difference between injured recruit and uninjured recruits for the FMS total score or the single-leg hop tests. The incidence of injury among recruits with a FMS total score of 14 or less. The incidence of injury among recruits with a FMS total score greater than 14 was 15%. The relative risk for musculoskeletal injury with an FMS score of 14 or less was 0.81. The P value (.83) associated with the relative risk indicates that the two groups were not different.

**CONCLUSIONS:** There was not a significant difference between the FMS total scores of injured and uninjured recruits. The mean FMS total score for all recruits indicates that most recruits were able to complete the FMS with minimal or no compensations. There was not a significant difference between the single-leg hop test scores of injured and uninjured recruits. The crosstabs test for distance displayed the largest difference in scores between the injured and uninjured recruits.

**CLINICAL RELEVANCE:** The FMS total score and single-leg hop tests were not associated with musculoskeletal injury during a fire academy.

**OPO144**

**RELATION BETWEEN RANGE OF MOTION AND PHYSICAL ACTIVITY WHILE RECOVERING AFTER TOTAL KNEE REPLACEMENT**

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**PURPOSE/HYPOTHESIS:** Standard postoperative physical therapy (PT) for total knee replacement (TKR) aims to increase knee range of motion (ROM), which is important for walking and adopting an active lifestyle, eg, taking more steps/day, after TKR [1-3]. However, it is unclear to what extent limited ROM may be a barrier to physical activity after TKR. This is important to study since ROM is a modifiable impairment that can be prioritized in PT after TKR. The purpose of this study was to evaluate the association of ROM with physical activity over the first 6 weeks of PT after TKR.

**NUMBER OF SUBJECTS:** We recruited 26 patients with a first time unilateral TKR from a local PT clinic. We excluded people with comorbidity that affected physical function other than arthritis.

**MATERIALS/METHODS:** We quantified physical activity as steps/day using an accelerometer enabled monitor (Actigraph GT3X) worn for at least 3 days during waking hours. Knee ROM was measured by a physical therapist using a standardized approach. We classified lacking greater than 5° of full knee extension as limited extension and knee flexion less than 95° as limited flexion [4]. We examined the difference in steps/day between those with and without limited knee ROM with physical activity each week of PT (weeks 1 to 6) using difference tests and 95% confidence intervals (CIs).

**RESULTS:** We included 26 people after TKR (mean ± SD age, 64.9 ± 9.1

**OP104**

**RELATION BETWEEN RANGE OF MOTION AND PHYSICAL ACTIVITY WHILE RECOVERING AFTER TOTAL KNEE REPLACEMENT**
years; BMI, 34.5 ± 7.5 kg/m²; 56% female) at baseline. Participants walked 1889 ± 1467 steps/d at week 1, and 3474 ± 2277 step/d at week 6. In general, there was little difference in steps/day between those with and without limited ROM. For instance, there was a nonstatistically significant difference in steps per day between those with limited extension (n = 20) compared with those without (n = 6) (776 steps/d; 95% CI: –2185, 633.26). In a similar fashion, there was little difference among those with limited flexion (n = 7) compared with those without (538 steps/d; 95% CI: –818, 1894). A small difference was observed at week 6 for extension. No participants had limited flexion after week 3.

CONCLUSIONS: Our preliminary findings show little difference in physical activity among people with and without ROM limitations after TKR. Directing PT interventions to areas other than ROM are important to consider after TKR to increase physical activity.

OP0145
PHYSICAL THERAPY UTILIZATION FOLLOWING AN EMERGENCY DEPARTMENT CONSULTATION FOR LOW BACK PAIN
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PURPOSE/HYPOTHESIS: The health care pathways through which patients with LBP access and receive care are variable [1,2]. The timing of physical therapy (PT) after accessing health care may influence health care utilization and costs [3,4]. The emergency department is a health care access point for many patients with LBP [5]. Little is known, however, regarding subsequent health care utilization. The purpose of this study was to evaluate the utilization and timing PT services following a new consultation to the ED for LBP and to describe the efforts to improve PT access.

NUMBER OF SUBJECTS: One thousand four hundred fifty-three.

MATERIALS/METHODS: This was a retrospective cohort study of patients who accessed the University of Utah Emergency Department for LBP between January 1, 2013 through December 31, 2014. Subjects were included if they had a new consultation to the ED with an associated LBP-related ICD-9 code and had no claims with a LBP-related ICD-9 and ICD-10 code for any service or provider in the preceding 90 days. We defined the date of the ED visit as the index visit. Participants were excluded if they had any red flag (fracture, cauda equine syndrome, infection, etc.), neuromusculoskeletal pain: nociceptive pain (NP), peripheral neuropathic pain (PNP), and central sensitization (CS). The purpose of this pilot study was to investigate the utilization of a Pain Classification Tool (PCT) in deter-
mining pain type in an outpatient clinical practice setting.

**NUMBER OF SUBJECTS:** Two licensed physical therapists utilized the PCT to assist in the identification of pain type in 228 patients who were referred to an outpatient orthopaedic physical therapy clinic with complaints of musculoskeletal pain.

**MATERIALS/METHODS:** The PCT included 32 criteria that defined symptom nature, duration, behavior, and severity in addition to physical signs and patient beliefs. The criteria were divided into 1 of 3 categories (NP, PNP, CS) based on best evidence and the current understanding of neurophysiology. The criteria were designed as a checklist. There were 8 criteria suggestive of NP, 5 criteria suggestive of PNP, and 9 criteria suggestive of CS.

After completing the patient examination, the therapist would utilize the PCT to determine the patient’s primary pain classification indicating the corresponding criteria present.

**RESULTS:** Utilizing the PCT, 157 patients were identified as NP (69%). An average of 4.5 criteria were identified as present with the most common being positive pain provocation testing, aggravation of pain symptoms with movement or loading, localized pain presentation pattern, and the absence of neurogenic descriptors. A total of 57 patients were identified as PNP (25%). An average of 3.3 criteria were identified as present with the most common being positive neural tension testing and the presence of neurogenic pain descriptors. A total of 14 patients were identified as CS (6%). An average of 7.7 criteria were identified as present with the most common being greater than 3 months in duration of symptoms, report of decreased quality of life, and qualifying scores on selected pain questionnaires.

**CONCLUSIONS:** This pilot study provides support for the use of the PCT in clinical practice to guide classification of pain mechanisms. There was not a case in which all criteria were present nor was there a specific criterion present in all cases for the NP or PNP classifications. These findings suggest variability in pain reports and patient presentation indicating a classification tool could be helpful to guide decision making. Further research is needed to determine the construct and criterion validity of the PCT.

**CLINICAL RELEVANCE:** Utilization of a PCT may assist in the diagnosis of musculoskeletal pain syndromes, improve intervention selection, facilitate patient centered plan of care development, and ultimately improve patient outcomes.

**OP0148**

**LENGTH CHANGE OF THE HIP EXTERNAL ROTATORS IN COMMON STRETCH POSITIONS**

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**PURPOSE/HYPOTHESIS:** The objective of this study was to evaluate length change of the piriformis, superior gemellus, obturator internus, and inferior gemellus during several commonly used stretch positions.

**NUMBER OF SUBJECTS:** Nine cadavers.

**MATERIALS/METHODS:** Seventeen hip joints from 9 embalmed cadavers (5 male, 2 female) aged between 49 and 98 years were skeletonized, leaving only the standard external rotators and joint capsule intact. Polypropylene strings were attached from the origin to insertion sites of the superior (SP) and inferior fibers (IP) of the Piriformis, Superior Gemellus (SG), Obturator Internus (OI), and Inferior Gemellus (IG) to represent the muscularotenous fibers of the short external rotators of the hip. The change of length (mm) noted by excursion of the strings when moved from the anatomical position to 4 specific stretch positions: (1) 45° internal rotation from neutral flexion/extension, (2) 45° external rotation with 90° hip and knee flexion, (3) 30° adduction from 90° of hip and knee flexion, and (4) 30° abduction with the limb positioned in hip and flexion with the lateral malleous in contact with lateral femoral epicondyle of the contralateral limb (aka, supine piriformis stretch) were recorded. A MANOVA with post hoc analysis determined the effect of the stretch position on the change of length of each muscle.

**RESULTS:** There was a significant effect on length change based on the stretch position, $F_{(3,16)} = 14.67, P < .0005$, Wilk’s $\lambda = 0.097$, partial $\eta^2 = 0.540$. The greatest length change for the SP (30.7 ± 10.2 mm) and IP (23.7 ± 7.8 mm) as well as the SG (20.8 ± 5.4 mm) occurred when positioned in 30° adduction from 90° of hip and knee flexion followed by 45° internal rotation from neutral flexion/extension (SP: 22.2 ± 5.9 mm; IP: 20.6 ± 5.3 mm; SG: 17.4 ± 3.0 mm) and 45° external rotation with 90° hip and knee flexion (SP: 19.4 ± 10.2 mm; IP: 10.4 ± 7.8 mm; SG: 9.4 ± 7.0 mm). The OI (18.2 ± 7.7 mm) and IG (15.3 ± 5.3 mm) had the greatest length change with 45° internal rotation from neutral flexion/extension followed closely by 30° adduction from 90° of hip and knee flexion (OI: 17.1 ± 6.0 mm; IG: 14.7 ± 7.2 mm). The supine piriformis stretch caused the least amount of length change for any of the muscles, ($P < .05$).

**CONCLUSIONS:** While all stretch positions caused a length change for the deep rotators of the hip, the 3 stretch positions that caused the greatest change were: (1) 30° adduction from 90° of hip and knee flexion, (2) 45° internal rotation from neutral flexion/extension, and (3) 45° external rotation with 90° hip and knee flexion.

**CLINICAL RELEVANCE:** Clinicians may apply the results of this study to select positions to effectively stretch the deep rotators of the hip. The piriformis and superior gemellus had a larger change in length when adducting the hip from 90° of hip and knee flexion. The obturator internus and inferior gemellus had a greater length change when internally rotating the hip from neutral flexion/extension.

**OP0149**

**THE ACCURACY OF 3 CLINICAL TESTS IN DIAGNOSING PROXIMAL HAMSTRING PATHOLOGY**

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**PURPOSE/HYPOTHESIS:** Studies are needed to investigate the clinical usefulness of tests for individuals with nonarthritic hip pain. The purpose of this study was to define the diagnostic accuracy of 3 tests in identifying individuals with proximal hamstring pathology.

**NUMBER OF SUBJECTS:** Forty subjects (30 female, 10 male).

**MATERIALS/METHODS:** Clinical records of individuals who underwent a physical examination, magnetic resonance imaging (MRI) and injection testing of the hip region due to posterior hip pain were retrospectively reviewed. A routine clinical examination was performed on each subject that included the active hamstring tests at 30° and 90° as well as noting pain at heel strike during gait. Sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, and diagnostic odds ratio were calculated for each test.

**RESULTS:** Subjects had a mean ± SD age of 48 ± 16.7 years (range, 15-71 years) and reported a mean ± SD symptom duration of 39 ± 39.3 days (range, 3-120 days). Using MRI imaging and injection testing as the gold standard, 26 out 40 (65%) were diagnosed and treated for proximal hamstring pathology. The sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, and diagnostic odds ratio for the active hamstring test at 30° knee flexion were 0.72, 0.97, 21.7, 0.29, and 75.4, respectively. For the active hamstring test at 90° flexion, sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, and diagnostic odds ratio values were 0.61, 0.97, 18.3, 0.40, and 45.6, respectively. For walking heel strike pain, sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, and diagnostic odds ratio values were 0.54, 0.71, 1.88, 0.65, and 2.92, respectively. The most accurate findings were obtained when the results of the active hamstring tests at 30° and 90° were combined with sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, and diagnostic odds ratio values of 0.83, 0.97, 25, 0.17, and 145, respectively.

**CONCLUSIONS:** The active hamstring tests at 30° and 90° of knee flexion
were valuable in diagnosing hamstring pathologies, while heel strike pain during gait was not useful.

CLINICAL RELEVANCE: The active hamstring test should be performed at both 30° and 90° of knee flexion to be most accurate in identifying those with and without proximal hip pathology.

OP0150

THE RELATIONSHIP BETWEEN CLINICALLY OBSERVED ABERRANT MOTION AND GLUTEAL STRENGTH IN YOUNG PATIENTS PRESENTING TO PHYSICAL THERAPY WITH LOW BACK PAIN

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PURPOSE/HYPOTHESIS: The pathomechanical behavior of spinal instability is ambiguous and poorly defined. In order to fully understand the change in movement patterns physical therapists need to be able to define the mechanism driving the altered movement. Gluteal muscle inhibition is often present in people with low back pain, most obviously in the return from flexion. This study was designed to determine if there is a clinically significant relationship between gluteal strength and aberrant motion in patients with low back pain. The tested hypothesis was the presence of impaired gluteus maximus strength would be positively correlated to the presence of aberrant motion. This hypothesis was investigated using retrospective data from the initial evaluations of patients with the diagnosis of low back pain from hospital based outpatient orthopaedic physical therapy clinic from April 2015 through March 2016.

NUMBER OF SUBJECTS: One hundred twelve patients.

MATERIALS/METHODS: Using the OT/PT/TR Divisional Patient Registry, evaluation data were pulled for patients seen between April 2015 and March 2016 for a spine evaluation. The data were sorted to determine which patients had values entered for both presence of aberrant motion and a MMFT grade for gluteus maximus strength. There were 112 patients (mean ± SD age, 16.1 ± 5.0 years) who met this criteria. For the purpose of this study patients’ who had “Within Functional Limits” or “Within Normal Limits” recorded for their strength values were not included. In addition for this study painful arc of movement was not considered aberrant motion. Chi-square analysis was used to determine the association between gluteal muscle strength and the presence of aberrant motion.

RESULTS: Twenty of 112 patients presented with 5/5 strength of which, 80% (16/20) had aberrant motion. 72/112 patients had 4/5 strength, 82% (59/72) presented with aberrant motion. 20/112 patients had 3/5 strength, 85% (17/20) had aberrant motion. Chi-square analysis suggested no significant difference in the proportion of patients who present with aberrant motion within each with gluteal muscle strength classification (3, 4 or 5). Approximately 80% to 85% of all patients with LBP presented with aberrant motion, regardless of glut max strength.

CONCLUSIONS: These finding support the null hypothesis that there is no evident correlation between gluteus maximus strength and aberrant motion. Further investigation is needed to determine if there is an objective measure that correlates with the presence of aberrant motion.

CLINICAL RELEVANCE: There is a lack of valid assessments for instability and the clinical prediction rule for lumbar instability has questionable validity in this population. Further research needs to be done to determine the underlying factors that influence aberrant motion. Though gluteal strength is impaired in the low back pain population it does not appear to have a clinically significant relationship to aberrant motion.

OP0151

MORE THAN KNEE PAIN: FEMALES WITH CHRONIC PATELLOFEMORAL PAIN DEMONSTRATE ALTERED PSYCHOSOCIAL RESPONSES

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PURPOSE/HYPOTHESIS: Patellofemoral pain (PFP) is a common orthopaedic condition that frequently becomes chronic in females. In other chronic pain conditions, reports of depression and feelings of hopelessness are reported which may reduce the efficacy of standard therapeutic exercise programs. Despite the chronic nature of PFP, treatment does not account for potential alterations in psychosocial factors, potentially limiting the effectiveness of treatment. In order to better understand the condition and begin improving treatment we sought to define the differences in reports of depression, kinesiophobia, pain catastrophizing, sleep quality, and quality of life between females with chronic PFP and control subjects. We hypothesized that females with chronic PFP would report significantly higher incidences of depression, kinesiophobia, pain catastrophizing, poor sleep, and fatigue on self-reported outcome measures when compared to a control group.

NUMBER OF SUBJECTS: Twenty-seven females with PFP (mean ± SD age, 25.8 ± 6.9 years; height, 1.67 ± 0.07 m; mass, 67.64 ± 10.26 kg) and 17 controls (age, 25.8 ± 6.8 years; height, 1.62 ± 0.07 m; mass, 58.25 ± 8.25 kg) were collected. For inclusion in the study, all subjects in the PFP group were required to have symptoms for at least 3 months.

MATERIALS/METHODS: Participants completed the following self-reported outcome scales: the Tampa Scale of Kinesiophobia (TSK), the Pain Catastrophizing Scale (PCS), the Fatigue Severity Scale (FSS), the Pain Self Efficacy Scale (PSEQ), and the Pittsburgh Sleep Quality Index (PSQI). Additionally, the participants completed a questionnaire about their PFP history, including the primary location of pain, frequency, and duration of symptoms, and a questionnaire about their history of depression/hopelessness. Independent 2-sample t tests were used to compare between groups.

RESULTS: We found significant differences in the following scales: PSQI (PFP, 5.0 ± 7.2; CON, 0.3 ± 1.4; P = 0.0004), FSS (PFP, 11.7 ± 2.7; CON, 3.5 ± 1.1; P < 0.0005), PCS (PFP, 9.2 ± 5.8; CON, 0.3 ± 1.4; P < 0.0005), PSEQ (PFP, 51.4 ± 8.6; CON, 59 ± 2.7; P = 0.001). Within the PFP group, 37% reported experiencing depression compared to 11% of the control group.

CONCLUSIONS: Females with chronic PFP reported experiencing poorer sleep, increased fatigue, higher kinesiophobia, increased pain catastrophization, and increased incidence of depression and feelings of hopelessness compared to the control group. The presence of chronic PFP appears to impact multiple psychosocial constructs, which may impair the efficacy of current treatment for PFP which is predominantly driven by therapeutic exercises.

CLINICAL RELEVANCE: The results suggest that females with chronic PFP are more likely to be depressed, sleep poorly, and have a greater fear of moving than controls. Physical therapists should consider the impact of this psychological profile on the patient’s presentation and adjust their treatment plans to include patient education and interventions to reduce fear of movement, depression, and pain catastrophization.

OP0152

WHAT IS THE BEST TIME TO USE THE START BACK TO PREDICT CLINICAL OUTCOMES IN PATIENTS WITH CHRONIC LOW BACK PAIN WHO RECEIVE PHYSICAL THERAPY?

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PURPOSE/HYPOTHESIS: The STarT (Subgroups Target Treatment) Back Screening Tool (SBST) is used to classify patients with low back pain into 3 risk categories of having a poor prognosis. However, this classification may change over time. In addition, baseline classification does not take into account variables that can influence the prognosis during treatment or over time. This study was designed to investigate what is the best time to using the SBST to predict clinical outcomes. Specifically, we investigated (1) the changes in the risk classification measured by the...
SBST over a period of 6 months and (2) the long-term predictive ability of the SBST when applied at different time points in Brazilian patients with chronic low back pain who have received a standardized physical therapy treatment.

**NUMBER OF SUBJECTS:** One hundred forty-eight.

**MATERIALS/METHODS:** This is a 6-month prospective cohort study nested into an existing randomized controlled trial. Were included patients with chronic nonspecific low back pain, of both sexes, aged between 18 and 80 years and who were seeking physical therapy treatment. Clinical outcomes of pain intensity, disability and global perceived effect as well as SBST were collected at baseline, after 5 weeks, 3 and 6 months. All patients received 10 sessions of physiotherapy based on general and specific exercises for low back pain and manual therapy. Three categories were created to evaluate the changes in the SBST subgroups, following the same categorization proposed by Beneciuk (improved, worsened, stable). Changes in SBST subgroups were calculated using descriptive statistics. Linear regression models were built to analyze the predictive ability of SBST when applied at different points of time.

**RESULTS:** After receiving good quality physiotherapy care, 60.8% changed their risk classification (54.7% improved the risk). The subgroup with the highest percentage of change (75%) was the medium risk. The SBST improved the prediction of disability, pain intensity and global perceived effect at 5 weeks, 3 months and changes from 5 weeks to baseline, after controlling for potential confounders (sex, age, duration of symptoms and the total score of the outcome at baseline). The SBST at baseline did not improve the predictive ability of the models after adjusting for confounding.

**CONCLUSIONS:** This study confirms partially the findings from Beneciuk et al 2014 showing that many patients change their risk subgroup after received physiotherapy care. The predictive ability of the SBST in patients with chronic low back pain increases when applied in different time points, especially after treatment and after 3 months.

**CLINICAL RELEVANCE:** Our results show the utility of the SBST for predicting the prognosis of patients who seek physical therapy treatment. Although the SBST at baseline does not add predictive information when controlling for confounding, the SBST is useful when applied after treatment.

**OP0154**

**IS ANKLE TAPING AN APPROPRIATE INTERVENTION FOR PREVENTING LATERAL ANKLE SPRAINS? A SYSTEMATIC REVIEW**

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**PURPOSE/HYPOTHESIS:** The ankle joint is one of the most injured joints in people participating in sports, representing up to 45% of all sports injuries and accounting for the most musculoskeletal injuries seen in the emergency department [1,2,3]. Approximately 85% of these ankle injuries are due to an inversion injury involving lateral ligament damage [4]. It is estimated that half of the general population sustains at least 1 ankle sprain during their life and as many as 55% of them do not seek injury treatment from a health care professional [5,6]. Furthermore, an initial ankle sprain leads to high rate of injury recurrence and can lead to chronic ankle instability, causing long term disability and degeneration [7,8]. For many years, providers have relied on ankle taping to reduce the risk of re-injury following an initial lateral acute sprain; however, the current evidence to support the use and effectiveness of prophylactic taping is unclear. The purpose of this systematic review was to evaluate the current evidence on the use of prophylactic taping use for reducing the risk of acute and recurrent lateral ankle sprains.

**NUMBER OF SUBJECTS:** Not applicable.

**MATERIALS/METHODS:** To conduct this systematic review, we used the basic search index using the combination of keywords “Taping” and “Ankle sprain” and restricted MeSH terminology to MeSH major topics, including functional ankle instability, chronic ankle instability, biomechanics, kinematics, and injury as subheadings. PubMed, MEDLINE and Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases were searched for studies that were randomized-controlled trial (RCT), published in English language, utilized human subjects, and used at least 1 ankle taping intervention.

**RESULTS:** Our initial review yielded 64 RCTs. After applying the screening criteria, 8 studies were analyzed using Sackett’s levels of evidence and were examined for scientific rigor.

**CONCLUSIONS:** The results suggested that ankle taping has no significant effect on preventing acute and recurrent ankle sprains in people with or...
without the history of ankle sprains. Ankle taping may affect the available range of motion at the ankle joint, and its effect on proprioception is debatable. A qualitative analysis suggested all included studies met at least 4 of 7 applied criteria with only 1 study meeting 6 of 7 criteria. Our review found ankle bracing to be more cost-effective and beneficial than ankle taping in reducing long-term risk of re-injury. There is a need for more well-designed and well-controlled RCTs to evaluate the effect of ankle taping on the incidence of acute and recurrent lateral ankle sprains. There is limited evidence to support the use of prophylactic ankle taping for reducing the risk of lateral ankle sprains in people with or without the history of ankle sprains.

CLINICAL RELEVANCE: Based on available evidence, health care professionals should consider using prophylactic bracing over prophylactic taping to prevent lateral ankle sprains.

**OP0155**

**IMPACT OF A 24-HOUR EDUCATIONAL PROGRAM FOR CONSERVATIVE PRIMARY CARE PRACTITIONERS ON ATTITUDES AND BELIEFS ABOUT SPINE PAIN MANAGEMENT**

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**PURPOSE/HYPOTHESIS:** There is increased recognition that health conditions represent complex interactions of biological, psychological, and sociological factors. The biopsychosocial (BPS) model represents a paradigm shift in health care, superseding the biomedical framework in the diagnosis and treatment of health conditions. Nowhere is this more important than in the management of spine pain. Many health care providers, however, including conservative providers such as physical therapists (PTs) and chiropractors (DCs), are acculturated in the biomedical model through formal education. As conservative providers move toward assuming primary care roles for spine related problems, their orientation to the biomedical and BPS models of care is essential. The purpose of this study is to investigate the impact of a 24-hour spine pain management program on the relative orientation of conservative care providers to biomedical versus BPS approaches to care.

**NUMBER OF SUBJECTS:** Participants included a total of 70 PTs and DCs attending the Excellus BC/BS spine care pathway (SCP) education program in upstate NY.

**MATERIALS/METHODS:** The SCP program is evidence-based, spine management education designed to prepare PTs and DCs as primary spine practitioners. The Patient Attitudes and Beliefs Scale (PABS) was utilized to measure the relative orientation of participants toward the biomedical and BPS models of care. The tool was administered at the beginning of the 4-day program, and immediately following the program. There were 2 cohorts: 50 participants completed the program in the fall of 2015, 20 participants completed the program in the spring of 2016. Simple t tests were used to compare pre and postprogram scores on both the biomedical and BPS subscales of the PABS.

**RESULTS:** Combined scores for both cohorts are reported. Pre and post-test biomedical subscales were 54% and 45.2%, respectively. Pretest and posttest BPS subscales were 57.6% and 59.9% respectively. The decrease in biomedical scores and increase in BPS scores were statistically significant (P<.05).

**CONCLUSIONS:** A 4-day spine management program based upon the BPS model of care impacts the relative orientation of health care providers toward the biomedical and BPS models of care; providers demonstrate a shift in their orientation in favor of the BPS model of care.

**CLINICAL RELEVANCE:** Clinical guidelines for neck and back pain consistently support a BPS approach to patient management. Healthcare provider attitudes and beliefs toward spine pain influence clinical decision-making, and therefore adherence to evidence-based practice. As physical therapists and other conservative providers evolve in their roles as primary spine practitioners, it is important that their clinical behaviors are aligned with current best practice.
not respond well to these traditional rehab approaches [1,3–6]. This case study describes the rationale and outcomes of an alternate treatment approach, using the concepts of cross-education and the mirror neuron system, for a patient with chronic pain and weakness 9 months post-ACLR.

**CASE DESCRIPTION:** The patient was an active 24-year-old who received ACLR with patellar autograft 8 months after initial injury, but required a second arthroscopic procedure to address arthrofibrosis. She received 5 months of standard rehabilitation, with continued limitations noted with range of motion, quadriceps strength, gait mechanics, and functional mobility. Due to the poor response to a traditional protocol, the patient was then enrolled in a mirror therapy program at 3 times a week for 8 weeks. Five exercises were performed each session using the uninvolved limb only. A mirror was placed between the 2 limbs, reflecting the uninvolved limb to the space overlying the involved limb.

**OUTCOMES:** Biodex testing on the involved lower extremity demonstrated improved peak isometric knee extension torque from 38.5 ft-lb to 68.2 ft-lb Isokinetic peak extension torque improved from 27.9 ft-lb to 39.9 ft-lb and total work produced from 402.1 ft-lb to 689.4 ft-lb at 300°/s. Single-leg anterior reach increased from 46 cm to 57.2 cm and single-leg sit to standing increased from 20 to 30 repetitions. Limb symmetry index of the above measures trended towards improved symmetry throughout the study. Girth measurements remained relatively unchanged on the involved limb. The patient's Knee injury and Osteoarthritis Outcome Score (KOOS) declined gradually throughout the study, with changes from initial to final measurement as follows: Symptoms 46.5 to 36, Pain 72.3 to 59, ADL 96 to 88.3, Sport/recreation 60 to 45, and Quality of Life 69 to 44. Self-reported pain scores peaked during the midpoint of the study, correlating with an increase in the patient's activity levels at that time.

**DISCUSSION:** A top-down treatment approach was incorporated in this case study, through cross-education and activation of the mirror neuron system with the uninvolved limb. This approach used the concepts of cross-education and cortical activation [7–10]. It is likely that this patient's self-reported disability trended more closely to her pain levels than her performance on strength and functional measures, explaining the decline in KOOS scores. The gains in strength were likely due to cortical and neuromuscular adaptations since quadriceps girth was relatively unchanged. This case demonstrates the potential utility of mirror therapy to improve strength and performance in patients with chronic pain and weakness post-ACLR.

**REFERENCES:**

fraspinatus muscle and a 75% external rotation strength deficit. A musculoskeletal ultrasound imaging exam was performed by an experienced orthopaedic physical therapist using a Supersonic Imagine with a HFL 15-MHz probe. With the subject prone, the infraspinatus muscle belly and tendon, posterior glenohumeral joint, spinoglenoid notch were imaged in long axis directly along the fibers of the infraspinatus muscle with the probe oriented inferior and parallel to the spine of the scapula. Poor definition and heterogeneity of the internal architecture of the infraspinatus muscle compared to normal appearing deltoid muscle overlying it as well as the supraspinatus suggested atrophy associated with denervation or rotator cuff tear. Dynamic MSK US further revealed an absence of muscle thickness changes during active abduction and external rotation resistance testing as compared to the contralateral shoulder. Reduced muscle bulk in addition to the ecchogenic changes to the internal architecture of the infraspinatus muscle suggested atrophy associated with denervation.

**DISCUSSION:** MSK US revealed information not present in the clinical examination. Architectural changes in the infraspinatus muscle were consistent with denervation atrophy, not rotator cuff tear nor disuse, and was subsequently confirmed with EMG testing. The normal appearance of the supraspinatus muscle suggested that a suprascapular nerve lesion occurred distal to the innervation of the supraspinatus muscle. These MSK US findings helped guide the prognosis for the patient's recovery and helped better define the nature of the patient's symptoms of weakness and fatigue with upper extremity exercises.


**OP0160**

**USE OF MUSCULOSKELETAL ULTRASOUND IMAGING TO AID IN THE DIAGNOSIS OF SUPRASCAPULAR NEUROPATHY: A CASE REPORT**  
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**BACKGROUND AND PURPOSE:** Shoulder dysfunction is a common reason for people to seek care from a physical therapist. The purpose of this case report is to examine infraspinatus muscle atrophy and the use of musculoskeletal ultrasound (MSK US) imaging by a physical therapist to determine if the appearance was similar to denervation injury, rotator cuff tear, or disuse atrophy.

**CASE DESCRIPTION:** A 28-year-old Caucasian woman (height, 1.6 m; weight, 54.1 kg; body mass index, 21.1 kg/m²) reported directly to an outpatient clinic complaining of right shoulder weakness with pushups and repeated overhead activities. The past surgical history was remarkable for a distal clavicle excision with a coracoclavicular ligament reconstruction 3 years prior to this encounter [1].

**OUTCOMES:** Clinical observation revealed marked atrophy of the right in-
the physical exam was completed. Subjects with a diagnosis of calcific tendinitis, adhesive capsulitis, those with prior shoulder surgery, and glenohumeral osteoarthritis were excluded from the study. A positive SRT was defined as restoration of strength with the scapular retracted and arm elevated 90° in the plane of the scapula. A negative SRT was defined as continued weakness (or the arm dropping). Statistical analysis was conducted to assess the clinical utility of the test maneuver.

**RESULTS:** The prevalence of full thickness RC tears in the study population was 54% (180/331). The average age of the RC tear group was 54.3 with 80 males and 100 females. There were 180 patients that had a full thickness tear confirmed on MRI. Of these 180, the scapular retraction test was positive in 147 patients and positive for the remaining 33. One hundred and fifty one subjects were diagnosed with an intact RC by MRI, 122 of which had positive SRT and 29 were negative. The average age of these subjects was 54.6 with 74 males and 77 females. The sensitivity was 81.7 (95% CI: 77.2, 85.4), specificity 80.8 (95% CI: 75.5, 85.3), accuracy of 81.2 for the SRT to diagnosis a full thickness RC tear. The positive predictive value was 83.5 (95% CI: 73.5, 93.5), negative predictive value 78.7 (95% CI: 67.7, 89.7), positive likelihood ratio of 4.3 (95% CI: 3.1, 5.8), negative likelihood ratio of 0.23 (95% CI: 0.17, 0.30), diagnostic odds ratio of 18.7 (95% CI: 10.4, 34.0), and number need to diagnose and misdiagnose of 1.8 (95% CI: 1.5, 2.2) and 4.6 (95% CI: 3.7, 5.8), respectively.

**CONCLUSIONS:** The results of this diagnostic study indicate that the SRT is influential in identifying the status of the RC based on its likelihood ratios. We found that the SRT renders a moderate shift in probability for the presence or absence of an intact RC tendon(s). Continued study is underway to determine if alternate scapular positioning has similar or different diagnostic capability in differentiating intact from full-thickness RC tears.

**CLINICAL RELEVANCE:** Clinicians may use the SRT to provide additional clinical insight on the status of the RC and avoid or delay unnecessary imaging studies after a trial of nonoperative physical therapy rehabilitation.

**OP0162**

**CAN 5 MINUTES OF REPEETITIVE PRONE PRESS-UPS AND SUSTAINED PRONE PRESS-UPS FOLLOWING A PERIOD OF SPINAL LOADING REVERSE SPINAL SHRINKAGE?**

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**MATERIALS/METHODS:** Fifteen participants between the ages of 18 to 65 who engage in sport or play an instrument 2+ times per week participated in this study. In addition, retrospective analysis of previously collected data from 30 additional similar participants were used to assess validity. All participants had shoulder pain that impacted their participation in work, school or recreation.

**RESULTS:** The within day reliability was excellent with an ICC of 0.935 (95% CI: 0.890, 0.959). The between day reliability was very good with an ICC of 0.890 (95% CI: 0.631, 0.982). The Pearson Correlation between the PSS and SPAM-DASH was −0.428 (95% CI: 0.236, 0.631), indicating a fair correlation that is directionally appropriate given that the PSS measures function and the SPAM-DASH assesses disability. The minimal detectable change (MDC) for the SPAM-DASH was calculated at both the 90% and 95% confidence intervals: MDC90 = 7.02; MDC95: 1.96 × 3.01 × 1.414 = 8.34.

**CONCLUSIONS:** The SPAM-DASH is a 4-item subset of the QuickDASH. It is a reliable tool to assess disability related to patient-specified activities. Correlation to the PSS was fair but directionally appropriate, suggesting the SPAM-DASH may be quick and efficient alternative to the lengthy PSS.

**CLINICAL RELEVANCE:** The SPAM-DASH provides patient-specific information, unlike the rest of the Quick-DASH or PSS. The SPAM-DASH may capture information missed due to the ceiling effect of the PSS or Quick DASH for the higher functioning and more active patient. More research is needed to assess the minimal clinically important difference for the SPAM-DASH in order to better support its use in a clinical setting.
OP0164  
**EFFECTS OF HIGH-INTENSITY EXERCISE ON CENTRAL NEURAL DRIVE IN HEALTHY POPULATIONS**

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**PURPOSE/HYPOTHESIS:** The purpose of this systematic review was to examine the effects of high intensity strength training (HIST) on central neural drive. For this review of literature, HIST was defined as greater than 75% of maximal volitional contraction (MVC).

**NUMBER OF SUBJECTS:** Five RCTs (n = 94 healthy subjects) were evaluated.

These studies investigated high intensity strength training and changes in central neural drive. All studies compared a training group and control group. Sample sizes ranged from 14 to 23 participants. The age of participants ranged from 18 to 35 years old.

**MATERIALS/METHODS:** Five databases were used in primary searches: Ovid, PubMed, CINAHL, Cochrane, Scopus. Searches were performed using the following terms: "motor drive and exercise," "motor evoked potential and exercise," "voluntary activation and exercise," "motor drive and high intensity," "voluntary activation and high intensity," "motor evoked potential and high intensity." Additional information was solicited from 1 primary source via email. The initial search yielded 1692 articles. Multiple levels of review yielded 10 articles which were critically appraised. Five articles were included in the final review. These 5 articles were rated for study design quality using the MacDermid Score.

**RESULTS:** Methodological quality MacDermid quality scores ranged from 28 to 34 out of 48. Effects of HIST all studies demonstrated significant increases in strength with short-term HIST. Participants demonstrated increased voluntary activation and/or increased cortical excitability with minimal or no hypertrophy, indicating neural mechanisms rather than morphological changes (ie hypertrophy, hyperplagia, etc) were, at least in part, responsible for increases in strength.

**CONCLUSIONS:** This review of the literature found evidence for increases in central neural drive due to HIST. Neural adaptations to HIST occurred rapidly and strength gains were seen across a range of muscle groups with both eccentric and concentric muscle training.

**CLINICAL RELEVANCE:** There are a variety of potential clinical applications supported by the findings of this review. Patients with an inability to effectively train both sides of the body due to immobilization, may benefit from neurologic overflow into the immobilized side when the unaffected side is trained. It may also be possible to capitalize on the rapid cortical adaptations in patients that need strength gains in a limited time frame, for instance preoperatively.

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OP0165  
**CHRONIC LEFT ARM POST-C5-7 ANTERIOR CERVICAL DISC FUSION MANAGED WITH A BIOPSYCHOSOCIAL MULTIDISCIPLINARY TEAM APPROACH AND PAIN NEUROSCIENCE EDUCATION**

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**BACKGROUND AND PURPOSE:** The biomedical (BM) approach to chronic pain is widely acknowledged as inadequate and results in subpar outcomes compared to a comprehensive biopsychosocial (BPS) approach. However, there is a significant gap between this knowledge and its clinical application. The purpose of this case report is to outline an episode of care (EOC) for a patient status post C5-7 anterior cervical disc fusion (ACDF) with left arm pain for greater than 1 year who was managed in a collaborative setting by specialists from physical medicine and rehabilitation (PMR), physical therapy (PT), and neuropsychology (NPx).

**CASE DESCRIPTION:** The patient was a 37-year-old female middle school teacher and triathlete with insidious 12-month onset of diffuse left upper extremity, right upper trap, bilateral periscapular, and neck pain. Previous treatment included PT at a different clinic for 2 months prior and 3 months postsurgery with an emphasis on BM limitations as per the patient report. Her initial exam in PT was consistent with central sensitization with yellow flags of social withdrawal, short term work disability, and severe anxiety. A coordinated plan of care was designed during a meeting with specialists from PMR, PT, and NPx. The purpose of this meeting was to review the patient’s electronic medical record (EMR) and gather input from all 3 disciplines, which resulted in a comprehensive BSP plan of care for the patient. All 3 specialists agreed that all interventions and education should be directed away from a typical BM model and encompass all aspects unique to this particular patient’s pain experience. Ongoing discussion throughout the EOC continued via the EMR messaging system. PT included manual therapy, exercise, and PNSE regarding neurophysiology of pain, central sensitization, spinal inhibition and facilitation, plasticity of the nervous system, and no reference to anatomical or pathoanatomical models. Homework after each session included review of concepts presented during the visit, viewing of YouTube videos to reinforce education, self-massage for desensitization, and regular cardiovascular exercise at moderate intensity.

**OUTCOMES:** The patient was seen in PT for a total of 6 visits over 9 weeks. Initial Neck Disability Index (NDI) score, numeric pain rating (NPR), and Fear Avoidance Components Scale (FACS) were 62%, 7/10, and 77%, respectively. After 2 months of PT the NDI, NPR and FACS scores were 14%, 6/10, 11%, respectively. At the time of her last PT appointment the patient had returned to training for a triathlon, full time work, and felt comfortable interacting again in social situations.

**DISCUSSION:** As the evidence builds to support the BPS approach to chronic pain there is a need to further define what that approach looks like in a typical outpatient PT clinic. In this case report the use of specialists from 3 disciplines working together to reinforce the same message to the patient was effective in managing the pain experience unique to this particular patient.

**REFERENCES:**
The KOOS was administered at initial evaluation and every 2 weeks that the patients attended PT. The KOOS scores on the individual subsections were compared statistically between the 2 groups using a mixed procedure linear model with SAS statistical package. Descriptive statistics were run as well as correlative statistics to determine statistically significant differences between the groups on the KOOS.

**RESULTS:** There were no statistically significant differences between the 2 groups on any of the KOOS scores at baseline, nor any demographics such as age, sex, BMI, etc. All individuals showed a statistically significant improvement in KOOS scores over time (P<.0001). When the 2 groups were compared using those patients who had completed at least 6 weeks of PT, there was a statistically significant difference seen in the KOOS subscales of symptoms (P = .045) and quality of life (P = .027), and approached a statistically significant difference in the KOOS subscale of pain (P = .077).

**CONCLUSIONS:** Patients who finished 6 weeks of physical therapy with an accelerated rehab protocol reported significantly less pain and symptoms and increased quality of life than those who attended PT less frequently.

**CLINICAL RELEVANCE:** The findings of this research suggests that there may be a benefit to an accelerated rehabilitation protocol with increased frequency of outpatient PT visits following TKA surgery.

**OP0168**

**USE OF ORTHOPAEDIC MANUAL THERAPY AND THERAPEUTIC EXERCISE FOR TREATMENT OF DIZZINESS WITH CERVICOGENIC HEADACHE**

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**BACKGROUND AND PURPOSE:** Physical therapists need to evaluate and when appropriate, treat the vestibular system and cervical spine to reduce dizziness associated with headaches. The purpose of this case report is to demonstrate the need to evaluate, and when appropriate, treat the cervical and thoracic spine to reduce dizziness associated with headaches.

**CASE DESCRIPTION:** The patient was a 27-year-old woman who was referred to outpatient physical therapy with a diagnosis of vertigo. At initial examination, primary symptoms consisted of dizziness, imbalance, headaches that originated to the left side of the occiput, and cervical pain. Initial examination findings were negative for peripheral vestibular dysfunctions. Positive examination findings included limited cervical range of motion, decreased passive joint mobility of the subcranial and thoracic spine, and decreased strength of the scapulothoracic musculature. Outcome measures consisted of the numeric pain rating scale, the Neck Disability Index, the Dizziness Handicap Inventory, and the Patient Specific Functional Scale. Treatment consisted of manual therapy techniques to the cervical and thoracic spine, therapeutic exercises to the upper quarter, and patient education over an 8-week episode of care.

**OUTCOMES:** Interventions decreased cervical spine pain and headache intensity. Complaints of dizziness decreased as headache intensity decreased. At discharge, the patient reported 0/10 cervical pain, Neck Disability Index score improved from 40% to 18%, Dizziness Handicap Inventory score improved from 46 to 18, patient specific functional scale average scores improved from 4.3 to 5.0.

**DISCUSSION:** This case report identifies an undiagnosed cervical dysfunction, cervicogenic headache, in association with dizziness. In similar cases, clinicians may only attempt to treat the dizziness because it was the diagnosis listed on the referral from the physician. Physical therapists need to combine a thorough subjective and objective assessment to determine the cause of cervical pain, headache, and dizziness. Specific questioning and assessment of positions that contribute to the onset, duration, and fatigability of symptoms can aide in differential diagnosis.


**OP0167**

**THE IMPACT OF AN ACCELERATED REHABILITATION PROTOCOL IN PATIENTS FOLLOWING MINIMALLY INVASIVE TKA WITH IOVERA**

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**PURPOSE/HYPOTHESIS:** Total knee arthroplasty (TKA) is one of the most frequently performed surgeries in the US, and the incidence is expected to grow in the next 15 years. This high volume continues to contribute to the escalating cost of health care. Iovera, a process of percutaneously freezing sensory nerves prior to surgery has been developed to decrease hospitalization and recovery time following TKA. With Iovera, patients have decreased postsurgical pain and are able to tolerate increased frequency of outpatient PT. This study investigated the impact of an accelerated rehab protocol on patient outcomes when compared to a more traditional frequency of outpatient PT visits following TKA surgery with the Iovera procedure.

**NUMBER OF SUBJECTS:** This study was a retrospective chart review of medical records of all patients who had a TKA from a single surgeon over a 2-year period. Patients were grouped into a high frequency (accelerated) or low frequency group (traditional) based on the number of PT visits attended in the first 3 weeks of outpatient PT. Individuals who attended at least 9 times in the first 3 weeks were considered high frequency and those who attended 8 times or less were grouped into low frequency. A total of 54 patient records were accessed, 25 in the low frequency group and 29 in the high frequency group.

**MATERIALS/METHODS:** The researchers accessed the PT charts for all 54 patients and gleaned data collected by the PTs. The outcome measure used was the Knee injury and Osteoarthritis Outcome Score (KOOS).

**RESULTS:** Of the 462 patients classified as stabilization, 45 met 2/4 criteria (9.7%), 160 met 1 criterion (34.6%), 150 met 2 criteria (32.5%), 84 met 3 criteria (18.2%), and 23 met all 4 criteria (5.0%). There were no significant associations between the number of criteria met and ODI change (F_{4,457} = 0.542, P = .705), pain change (F_{4,457} = 0.425, P = .790), or number of visits (F_{4,457} = 0.655, P = .623). In the hierarchical regression, each step of the model was significant. After step 1, with chronicity in the equation (R^2 = 0.035, F_{4,457} = 16.70, P < .001). After step 2, with all 4 of the criteria in the model (R^2 = 0.016, F_{4,457} = 4.90, P < .001). A positive prone instability test had a significant impact on ODI change (R^2 = 0.158, P = .033) in acute and subacute patients.

**CONCLUSIONS:** In this retrospective review the total number of CPR criteria met did not have a statistically or clinically significant impact on ODI change score in patients who were treated with lumbar stabilization exercises. Having a positive PIT test in a patient seen less than 6 months from onset of LBP did have a statistically significant impact on outcomes.

**CLINICAL RELEVANCE:** This retrospective review did not show any greater improvement in ODI change scores for patients who were treated with primary intervention of stabilization exercises and who met the stabilization CPR versus those who did not. This calls into question the clinical usefulness of the stabilization CPR and its utility as a subgroup within the TBC to direct clinicians towards most effective care. This conclusion is in alignment with other clinical commentaries recently published. More research is necessary to determine the need for the stabilization subgroup within the TBC.

OUTCOMES:


OP0169

TESTING WITH A CHRONIC PROXIMAL HAMSTRING TEAR: A CASE REPORT

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BACKGROUND AND PURPOSE: Proximal hamstring tears are commonly seen in the young, athletic population with an injury involving quick movements. While clinical recommendations have been published on the treatment of hamstring injuries, there is little literature on the physical therapy management of individuals with chronic hamstring tears. With a hamstring tear, neural provocation testing including straight leg raise (SLR) and slump is utilized to identify any sensitivity of the peripheral or central nervous system. The slump test is traditionally performed as seated spinal flexion, knee extension, and ankle dorsiflexion with cervical motions creating a change to distal symptoms. The purpose of this case is to describe the differential diagnosis and clinical reasoning process of an individual presenting with persistent buttock pain.

CASE DESCRIPTION: A 60-year-old woman presented with a 12-month history of right ischial tunneling pain. MRI confirmed a tear of the proximal hamstring tendons with 10 mm of retraction. Her buttock pain worsened to 8/10 pain with walking up hills, stair ascent, and sitting. At initial evaluation, standard slump testing and passive SLR testing with hip IR, adduction, and ankle dorsiflexion were negative. The tear was identified as the primary pain generator shown with pain upon palpation and reduced hamstring strength and flexibility. Nonthrust hip joint mobilizations, eccentric hamstring strengthening, soft tissue mobilization and hamstring stretching were utilized for 7 visits with a home exercise program. Due to minimal change on the Lower Extremity Functional Scale (LEFS), continued pain with aggravating activities, and the anatomical proximity of neural tissue to the hamstring origin, neural provocation testing of passive SLR with a combination of all sensitizing maneuvers including cervical flexion and slump testing with a neutral pelvis was performed resulting in positive findings. Seated, supine, and sitting neural mobilizations using cervical flexion while positioned in hip flexion, IR, adduction and a neutral pelvis were utilized for 6 additional sessions.

OUTCOMES: From the Visit 1 to Visit 8, her pain reduced from 8/10 to 4/10 at worst. Her global rating of change (GRoC) was +2. A little bit better, and her LEFS went from 51/80 to 53/80. With the addition of neural mobilizations, her pain was 1/10 at worst, GRoC was +6 A great deal better, and LEFS was 67/80.

DISCUSSION: Lack of improvement with hip mobilizations, stretching, soft tissue mobilization, and eccentric hamstring strengthening led to the reconsideration of a neurogenic component to the pain. Slump with a neutral pelvis and the addition of cervical flexion to an already sensitized SLR identified positive neurodynamic findings in this case. This nonirritable, chronic condition required clinical reasoning to identify positive neural provocation outside the standard SLR and slump testing positions and resulted in positive outcomes with the addition of neuromobilization interventions.


OP0170

THE VALIDITY OF THE SIT-TO-STAND TEST IN CLASSIFYING GLOBAL FOOT MOBILITY

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PURPOSE/HYPOTHESIS: The Sit-to-Stand (STS) test is a simple way to classify the overall mobility of a patient’s foot. The test involves comparing the change in a person’s nonweightbearing and weightbearing foot posture and then classifying their mobility as “Hypomobile,” “Hypermobile” or “Normal.” Unfortunately, the validity of this simple test has not been investigated. The purpose, therefore, of this study was to determine if the STS test has sufficient validity to be used clinically.

NUMBER OF SUBJECTS: Sixty-four.

MATERIALS/METHODS: Sixteen male and 48 female subjects with a mean ± SD age of 25 ± 4.1 years participated in the study. Each subject’s dorsal arch height (DAH) and midfoot width (MFW) was first measured at 50% of their overall foot length in nonweightbearing and weightbearing using a digital caliper or linear gauge. The change between the nonweightbearing and weightbearing measurements was then calculated for each foot. A global foot mobility measure, called the mobility magnitude (MM) was also calculated for each subject using the change in DAH and MFW. Using normative data for these measurements, the subject’s foot mobility was classified as “Hypomobile” (first quartile), “Normal” (second and third quartile), or “Hypermobile” (fourth quartile). Each subject’s foot mobility was then visually assessed and classified by 2 different raters as “Hypomobile” (less than 25% change), “Normal” (25%-75% change), or “Hypermobile” (greater than 75% change) without knowledge of the prior linear measurements. Rater 1 was inexperienced while Rater 2 was experienced in the evaluation and management of foot and ankle disorders. A series of Cohen’s kappa coefficients, adjusted for bias and prevalence, were used to assess the amount of agreement between the visual classifications of foot mobility and the objective linear measurements.

RESULTS: The kappa coefficients for the 2 raters ranged from 0.051 to 0.133 for DAH, from 0.109 to 0.309 for MFW and from 0.121 to 0.273 for MM. These kappa coefficients would be categorized as between “slight to fair” agreement. The kappa coefficients did not appear to be significantly influenced by the level of education or experience of the raters.
CONCLUSIONS: Both raters demonstrated between slight and fair agreement between the subjective visual assessment and the objective linear measurement of foot mobility. As such, it cannot be recommended as a clinical tool to classify overall foot mobility. Further research is warranted to find a better screening tool that can be used to easily and quickly classify overall foot mobility.

CLINICAL RELEVANCE: The STS test did not demonstrate sufficient agreement with the objective linear measurements of foot mobility to warrant clinical use to classify a patient’s overall foot mobility. Clinicians should rely on other methods of measuring or classifying global foot mobility.

OPO171

USING ABBREVIATED THERAPEUTIC NEUROSCIENCE EDUCATION AS AN ADJUNCT TO EXISTING MANUAL THERAPY AND THERAPEUTIC EXERCISE INTERVENTIONS IN THE TREATMENT OF CHRONIC KNEE PAIN IN A 59-YEAR-OLD MALE PATIENT WITH KNEE OSTEOARTHRITIS: A CASE REPORT

Maria Anjanette Nunez

Background and Purpose: Traditionally, physical therapy treatment of chronic knee pain associated with knee OA has been based on a biomedico- logical model, focusing on anatomical pathology. However, patients with chronic knee pain receiving an integrated physical therapy treatment program may still report pain and difficulty with performance of ADLs, leading to seek further treatment including surgery, steroid injections and reliance on pain medication. Research on pain neurophysiology has shown that individuals with moderate to severe symptomatic knee OA demonstrate central sensitization due to an altered central processing of pain. Therapeutic neuroscience education (TNE) is an effective intervention that individuals with moderate to severe symptomatic knee OA demonstrate central sensitization due to an altered central processing of pain.

Case Description: The patient was a 59-year-old man presenting to physical therapy with a chief complaint of a 2-year history of chronic right knee pain. At baseline and at a 4-week re-evaluation, pain and function were measured by the numeric pain-rating scale (NPRS) and the Lower Extremity Function Scale (LEFS). Fear-avoidance and pain catastrophizing were assessed using the Fear-Avoidance Belief Questionnaire physical activity (FABQ-PA) and work (FABQ-W) subscales modified to the knee and the Pain Catastrophizing Scale (PCS). Walking tolerance and functional active movements of squatting and kneeling were also assessed. Treatment consisted of 5 to 10 minutes of TNE at the beginning of each session, 3 times a week for 4 weeks in addition to an existing treatment plan of therapeutic exercise and manual therapy.

Outcomes: After 4 weeks of TNE education integrated into therapeutic exercise and manual therapy interventions, the patient’s LEFS increased by 110% (11 points). The patient had decreased fear-avoidance behavior (FABQ-PA score change from 24/24 at baseline to 7/24; PCS score change from 44/52 to 20/52). Pain at worst also decreased from 8/10 by 110% (11 points). The patient had decreased fear-avoidance behavior (FABQ-PA score change from 24/24 at baseline to 7/24; PCS score change from 44/52 to 20/52). Pain at worst also decreased from 8/10 by 110% (11 points). The patient had decreased fear-avoidance behavior (FABQ-PA score change from 24/24 at baseline to 7/24; PCS score change from 44/52 to 20/52). Pain at worst also decreased from 8/10 by 110% (11 points).

Discussion: Decrease in pain, fear avoidance for physical activity, pain catastrophizing, and improvement in functional outcome measure tools for function, and active functional movement over a 4 week span. The addition of TNE did not affect fear avoidance for work subscale. The results of this case report suggest that TNE can easily be integrated into a multimodal intervention model for the treatment of chronic knee pain associated with knee OA.

References:

OPO172

HAND DOMINANCE AND POSTURE: A STUDY OF HANDEDNESS PATTERNS IN POSTURE ANALYSIS

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Purpose/Hypothesis: The purpose of this study was to identify if hand dominance postural patterns, as described by Florence Kendall, can be identified in a standing posture assessment and if sex influences posture. Our hypothesis was that hand dominance and sex would have an effect on posture as demonstrated by measured postural deviations unique for each subset of participants.

Number of Subjects: Thirty-eight participants were recruited for our study, 12 males (32%) and 26 females (68%) with a mean age of 26 years. Thirty-two were right-handed (84%) and 6 were left-handed (16%). Inclusion criteria for our study included healthy male and female participants between the ages of 18 and 65 without any postural abnormalities.

Materials/Methods: Standing posture of each subject was analyzed against a plum line and posture grid in the lateral and posterior view in addition to photographic assessment. Measurements were taken for the cranioocular angle, shoulder levels, spinal alignment, pelvis and hip levels, knee alignment, and rearfoot pronation. Statistical analysis: frequencies were used to determine the presence of postural pattern associated with hand dominance and sex. A mixed-design, repeated-measures ANOVA was used to determine if there was a difference in the frequencies of each postural deviation observed for hand dominance and sex.

Results: No one demonstrated all 5 postural deviations descriptive of a
Combined Sections Meeting

handedness pattern. Of the possible 5 postural deviations, 3% (n = 1) of right-handed participants and 33% (n = 2) of left-handed participants demonstrated 3 characteristics associated with their hand dominance pattern, 34% (n = 11) of right-handed and 50% (n = 3) of left-handed participants presented with 2, 38% (n = 12) of right-handed and 0% of left-handed participants presented with only one, and 25% (n = 8) of right-handed participants and 16% (n = 1) of left-handed participants presented with none of the characteristics. There was no consistent posture pattern among the sexes. A repeated-measures ANOVA found that neither hand dominance or sex was statistically significant for any of the postural variables.

CONCLUSIONS: This study found that hand dominance and sex do not have an effect on a person’s posture. Thus, we rejected our hypothesis that hand dominance and sex would have an effect on posture as demonstrated by measured postural deviations unique for each subset of participants.

CLINICAL RELEVANCE: Participants exhibited multiple variations of Kendall’s proposed handedness posture patterns suggesting that there are other factors of greater influence on posture that should be given more important consideration than hand dominance and sex. Thus, clinicians should not assume that an observed postural pattern is due to hand dominance or sex.

OP0174

THE EFFECT OF LOWER EXTREMITY STRENGTHENING AND FLEXIBILITY ON PITCHING BIOMECHANICS IN PITCHERS WITH UPPER EXTREMITY INJURIES: A CASE SERIES

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BACKGROUND AND PURPOSE: Rehabilitation for overhead athletes typically focuses on upper extremity interventions, despite the fact that the pitching motion is a complex sequence of movements requiring the coordination of the lower extremities, pelvis, trunk and the upper extremities to achieve ball velocity. The purpose of this study was to compare the effectiveness on pitching performance of traditional upper extremity biased rehabilitation to traditional rehabilitation augmented with lower extremity focused interventions in pitchers with upper extremity injuries due to overhead throwing.

CASE DESCRIPTION: Five pitchers (mean ± SD age, 18.6 ± 4.7 years; weight, 181.0 ± 19.6 lbs, height, 73.6 ± 1.9 inches) with upper extremity pathology due to overhead throwing were recruited. Subjects were randomly assigned to receive standard care (SC group); traditional, upper extremity (UE) focused interventions or SC plus lower extremity (LE) interventions (hybrid group). Both stride LE (lead leg) and stance LE (push-off leg) was assessed. Subjects’ passive hip internal rotation (IR) and external rotation (ER) range of motion (ROM), knee flexion angle at lead foot contact, and shoulder ER ROM in late cocking was assessed while pitching with a 2-motion video capture system pre and post physical therapy intervention (12.6 ± 5.8 visits).

OUTCOMES: There was a significant decrease of the stride LE hip IR ROM for the SC group, compared to the hybrid group, (mean ± SD change, −6.5° ± 3.0°; P = .024). There was a significant increase in hip IR ROM of the stride LE (mean ± SD difference, 6.3° ± 3.3°; P = .014) and hip ER ROM of the stance LE (mean difference, 5.5° ± 3.4°; P = .050) postintervention between groups. There were significant changes, with an increase in knee flexion (mean ± SD change, +6.4° ± 8.4°; P = .022) and decrease in shoulder ER (mean ± SD change, −2.0° ± 3.1°; P = .037) seen in the hybrid group.

DISCUSSION: Implementation of traditional rehabilitation augmented with LE interventions could potentially assist with reducing stress on the throwing arm. Inhibiting the loss of stride hip IR and increasing knee flexion will decrease shoulder ER angle that will allow the efficient transfer of energy up the kinetic chain. Addressing stride length and direction with traditional upper extremity focused rehabilitation augmented by lower extremity intervention may improve the timing of the throwing shoulder during stride foot contact, decreasing the strain on the shoulder and elbow.

OP0175
SURGICAL INDICATIONS FOR FEMOROACETABULAR IMPINGEMENT WITH/WITHOUT ACETABULAR LABRAL TEAR: A SCOPING REVIEW
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PURPOSE/HYPOTHESIS: The prevalence of cam femoroacetabular impingement (FAI) is estimated to range from 5% to 75%, while pincer FAI prevalence is more consistently reported at 61% to 76% of patients presenting with hip and/or groin pain. The consistency of specific criteria reporting for diagnosis and surgical treatment of FAI appears unclear, despite recent suggestions for comprehensive and inclusive inclusion/exclusion criteria for FAI surgery. Therefore, the purpose of this review was to analyze and report the indications utilized for open and arthroscopic surgical treatment of FAI. We hypothesized that radiographic evidence of FAI would be the primary indication for surgery.
NUMBER OF SUBJECTS: Within the scoping review there were 10078 patients (56.2% male; mean age, 33 years) and 10 698 hips included from 110 articles matching the inclusion criteria.
MATERIALS/METHODS: A librarian assisted computer search of MEDLINE, EMBASE, and for articles related to surgical indications for FAI was employed for study inclusion. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were also used for the search and reporting phases of this study. Inclusion criteria for this review included: studies of subjects with surgical treatment of FAI, studies with the primary purpose of surgery or surgical outcomes for treatment of FAI, and studies with defined indications for FAI criteria.
RESULTS: Radiographic imaging (eg alpha angle, central edge, crossover sign) was a surgical indication in 78% of the included studies. Subjective history was a reported surgical indication in 74% of the studies, and special tests were reported in 69% of studies. Various range-of-motion limitations were described in only 28%, while 44% of included studies listed previous treatment (eg, NSAIDs, activity modification, PT) as indications for FAI surgery. Failed nonsurgical physical therapy treatment was only listed in 28% of studies, while 44% of included studies listed prior surgical treatment (eg, labral repair) as a surgical indication. Subjective history (eg, pain, range of motion limitations) was the most commonly reported indication for FAI surgery. Unfortunately, specific indications, as well as their specific parameters and values, demonstrated major inconsistencies across the studies.
CONCLUSIONS: As hypothesized, radiographic evidence of FAI was the most commonly reported indication for FAI surgery. Unfortunately, specific indications, as well as their specific parameters and values, demonstrated major inconsistencies across the studies.
CLINICAL RELEVANCE: The rate of surgical intervention for FAI is continuing to escalate despite poorly described and inconsistently reported surgical indications. The primary surgical indication for FAI surgery is currently radiographic imaging, despite a lack of consensus on the specific modalities and cut-off values necessary for this intervention. It remains unclear which indications determine best surgical outcomes for FAI.

OP0176
DORSIFLEXION MOBILITY IMPAIRMENTS AND THE REGIONAL INTERDEPENDENCE IMPLICATIONS ON FUNDAMENTAL MOVEMENT PATTERNS
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PURPOSE/HYPOTHESIS: The APTA recently issued a vision statement, grounded by the principle of optimizing movement. Physical therapists typically assess isolated movements at the joint level, as well as open and closed kinetic chain functional patterns. Correlation between the 2 are often implied, but research is limited in terms of demonstrating a correlation between specific impairments and movement dysfunction. The purpose of this poster is to demonstrate how dorsiflexion mobility impairments impact fundamental movement patterns.
NUMBER OF SUBJECTS: One hundred forty-six subjects.
MATERIALS/METHODS: An observational analytical cohort study was conducted. A sample of convenience of 146 collegiate athletes was obtained. The study was approved by the IRB of Lebanon Valley College. Inclusion criteria included: (1) self-reported lack of musculoskeletal injury within 6 months prior to data collection, (2) no musculoskeletal pain at time of testing, (3) medically cleared for sport participation by a physician. Informed consent was obtained from each subject. Closed chain dorsiflexion range of motion was assessed utilizing the lunge test as described by Chisolm. The squat movement pattern was assessed utilizing the Functional Movement Screen criteria. Statistical analysis was performed to explore the correlation between closed chain dorsiflexion limitations and a dysfunctional squat.
RESULTS: A cut score for limited dorsiflexion of less than 10 cm was set and a score of “1” on the deep squat test of the Functional Movement Screen were investigated. 67 (46.2%) Subjects scored either a “2” or “3” on their deep squat. Six of these subjects (9%) had both ankles dorsiflex less than 10 cm. 11 subjects (16.4%) had at least 1 ankle dorsiflex less than 10 cm. 78 subjects (53.8%) scored a “1” on their deep squat test. Of this group, 23 subjects (29.5%) had a bilateral dorsiflexion restriction and 33 subjects (42.3%) had an unilateral restriction. Subjects who scored a “1” on their deep squat test were 3.73 times as likely to have at least 1 ankle dorsiflex less than 10 cm compared to subjects who scored a “2” or a “3” on their deep squat test based on an odds ratio analysis (OR = 3.73; 95% confidence interval: 1.60, 8.88; P = .002).
CONCLUSIONS: A dysfunctional squat pattern can be correlated with a unilateral or bilateral lack of closed chain dorsiflexion mobility. Clinicians who identify a dysfunctional squat utilizing the Functional Movement Screen or assessing a functional task may benefit from looking at closed chain dorsiflexion mobility. Ankle equinus may limit the ability to squat for functional tasks placing excessive stress on more proximal body structures.
CLINICAL RELEVANCE: Physical Therapists have an obligation to effectively manage the complex neuromusculoskeletal system with the goal of reducing the activity limitations in our patients. Considering regional interdependence implications, movement dysfunction can be a product of clinically meaningful impairments within the kinetic chain. To this end, a key component to our management model should center on fundamental movement restoration.
dorsum of the distal forearm 2 cm proximal to subjects’ radial styloid pro-
cess. Each subject was returned to the NCS posture for subsequent lateral
rotator strength testing after 5 minutes in a protruded (PCS) cervical sit-
ting posture, 5 additional minutes in the NCS posture and 5 minutes in a
retracted (RCS) cervical sitting posture. Subjects were randomized for or-
der between the PCS and RCS postures.

RESULTS: Mean strength values for each condition were normalized for
each subject to the initial NCS posture mean strength values. ANOVA
demonstrated significance for shoulder lateral rotator strength decline
defining the total length of stay (LOS) in therapy (from initial evaluation
to discharge) and a mixed model ANOVA (tear size by biceps group) over phase of re-
development of improvement PT utilization in emerging value-based pay-
ment models.

CONCLUSIONS: The results of this study indicate that tear size and biceps
procedure influence PT utilization. In this sample, patients with a biceps
procedure tended to have less utilization overall as measured by LOS and
PT visits. Tear size was likely influenced by early post operative restric-
tions based on tear size.

CLINICAL RELEVANCE: Clinicians should consider tear size and concurrent
biceps procedure when developing postoperative expectations following
RCR repair. Understanding the factors that influence will help guide de-
velopment of improvement PT utilization in emerging value-based pay-
ment models.

OPO178

INFLUENCE OF TEAR SIZE AND BICEPS PROCEDURE ON PHYSICAL
THERAPY UTILIZATION FOLLOWING ROTATOR CUFF REPAIR
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PURPOSE/HYPOTHESIS: There are between 250 000 and 400 000 rotator
cuff repairs (RCR) per year in the United States. Evidence suggests that
associated long head of the biceps (LHB) tendon pathology should be ad-
dressed in these patients often impacting the physical therapy (PT) plan
after RCR. While standard practice following RCR involves regular, su-
 pervised PT visits, there is no clinical evidence describing dosage of PT
following RCR as it relates to tear size and concomitant biceps proced-
ure. Therefore, the purpose of this study was to examine the effects of
RCR tear size and concomitant biceps procedure on PT utilization follow-
ing RCR.

NUMBER OF SUBJECTS: Patients with RCR (n = 114; tenodesis, 51; tenotomy,
63) by 1 of 3 board certified, fellowship trained surgeons who received
therapy at 1 physical therapy (PT) clinic following a previously published
rotator cuff protocol.

MATERIALS/METHODS: Patients were included if they had an index RCR with
available pre surgical MRI, operative report, and pre- and 2-year postop-
erative ASES scores. Baseline factors including age, sex, BMI, comorbidi-
ties, work type, activity level, pain were recorded. PT utilization was de-
defined as the total length of stay (LOS) in therapy (from initial evaluation
until time of discharge) and number of visits at 6 weeks, 12 weeks, and 3
to 6 months. Tear size was categorized as less than 3 cm (n = 50) or great-
er than 3 cm (n = 64). A 2-way ANOVA (tear size by biceps procedure)
was used to compare the LOS and dosage of visits over the course of care
and a mixed model ANOVA (tear size by biceps group) over phase of re-
habilitation on visits (α = .05).

RESULTS: ASES scores (pre, 36.5 ± 11.6) increased on average 45.1% ±
18.4% with 24.2 ± 13 visits across all patients. There were significant in-
teraction effects of for visits (P = .04) and LOS (P = .002). Post hoc anal-
ysis showed that patients with a tenodesis were seen 2.4 visits fewer if
they were greater than 3 cm compared to RCR less than 3 cm and teno-
desis during 0 to 6 weeks. Overall, patients with RCR less than 3 cm and
tenotomy (4.6 ± 6.8) were seen less than those with tenodesis (7.8 ± 7.7).
When considering LOS, patients with tenotomy had shorter LOS (LOS,
94.6 ± 117.6) compared to patients with tenodesis (LOS, 129.6 ± 70.0) fur-
thermore, patients with tenotomy and RCR less than 3 cm had shorter
LOS (LOS, 66.2 ± 161.1) compared to all other groups. Patients with RCR
greater than 3 cm had longer LOS (123.0 ± 71.4) compared to patients
with RCR less than 3 cm (93.9 ± 127.1).

CONCLUSIONS: The results of this study indicate that tear size and biceps
procedure influence PT utilization. In this sample, patients with a biceps
procedure tended to have less utilization overall as measured by LOS and
PT visits. Tear size was likely influenced by early post operative restric-
tions based on tear size.

CLINICAL RELEVANCE: Clinicians should consider tear size and concurrent
biceps procedure when developing postoperative expectations following
RCR repair. Understanding the factors that influence will help guide de-
velopment of improvement PT utilization in emerging value-based pay-
ment models.

OPO179

NORMATIVE VALUES FOR THE Y BALANCE TEST IN HEALTHY, ACTIVE
YOUNG ADULTS
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PURPOSE/HYPOTHESIS: Single-limb balance and dynamic neuromuscular
control are important for daily and sport-related activities. The Y Balance
test is a valid and reliable measure for assessing single limb balance and
neuromuscular control. Scores on the Y Balance test have been related to
lower extremity musculoskeletal impairments and predictive of lower ex-
tricular injury in select populations. Despite its widespread clinical utility,
appropriate reference values have yet to be established for healthy, active,
young adults. Normative values based on age, sex, and activity would al-
low clinicians to correctly interpret test results to determine patient per-
formance and to establish values to be used for screening a young adult
population. The purpose of this study was to establish normative values
for the Y Balance test in healthy, active, young adults (age range, 20-29
years), Secondary aims included assessment of sex differences in normal-
ized reach direction and composite scores.

NUMBER OF SUBJECTS: Seventy-four.

MATERIALS/METHODS: Healthy young adults between the ages of 20 and 29
years who exercised 1 to 2 d/wk were recruited to participate in this study.
Successful reach distances were recorded for each direction and the aver-
age for each direction was utilized in calculations. Distances for each di-
rection were normalized to limb length. Composite scores were also calcu-
lated for each L.E. Sex differences were assessed between groups for each
reach direction and composite scores using an independent t test (P<.05).
Reference values were calculated for posterior-medial, posterior-lateral,
and anterior and composite scores for each lower extremity (mean ± SD, 95%
certainty interval).

RESULTS: Seventy-four subjects (43 female, 31 male) met inclusion criteria
and completed the Y Balance test. There were no statistically significant
differences between males and females in right and left anterior reach (P
= .407, P = .395), right and left posterior medial reach (P = .702, P = .759),
right and left posterior lateral reach (P = .756, P = .759). Mean reach distances for each direc-
tion were as follows: right and left anterior (62.7 ± 11.1 cm), right and left
composite reach (P = .615, P = .756). Reach mean distances for each direc-
tion were as follows: right and left anterior (67.7± 9.13 cm, 67.21 ± 10.23),
right and left posterior medial (107.86 ± 15.21, 110.12 ± 13.77) and right
and left posterior lateral (102.49 ± 15.96, 103.26 ± 15.46). Mean reach dis-
tances for composite scores were (96.79 ± 11.58) cm for RLE, and (97.34
PULSE was delivered at the subjects’ peak twitch amplitude. The data were the tests, an MVC was performed and a 200-microsecond wide doublet counted for by an inability to generate and sustain trunk extensor moment. Higher in HC compared to cLBP (12.4; SE, 1.5 versus 7.9; SE, 1.4 Nm, respectively) line trunk extensor moments were significantly lower in subjects with cLBP than in HC (20.5 Nm; SE, 5.8 versus 40.7; SE, 6.3 Nm, respectively) of the trunk extensors during the first session; visual feedback of the extensor moment was considered to be maximal effort. For the standard Sörensen test session, only the weight of the platform was counter-balanced. For the modified test session, the counterweight load was set to 30% of the subjects’ maximal trunk extensor moment to maintain the horizontal position. During both sessions, the subjects viewed digitally displayed feedback on trunk position from a potentiometer mounted on the platform. Task failure occurred when the subjects could not maintain the horizontal position (±1°) for greater than 3 seconds. Following each of the tests, an MVC was performed and a 200-microsecond wide doublet pulse was delivered at the subjects’ peak twitch amplitude. The data were analyzed with a mixed model ANOVA.

RESULTS: TTF was 139 (SE, 13.9) seconds for the HC group and 93 (SE, 13.0) seconds for the cLBP group (P < .05). Collapsed across groups, TTF was 166 (SE, 16.9) seconds in the modified test compared to 66 (SE, 6.6) seconds in the standard Sörensen test (P < .05). Baseline vertical forces at the trunk (441 N for HC versus 460 N for cLBP) and hip (491 N for HC versus 437 N for cLBP) did not differ between groups. However, baseline trunk extensor moments were significantly lower in subjects with cLBP than in HC (20.5 Nm; SE, 5.8 versus 40.7; SE, 6.3 Nm, respectively; P < .05). Peak extensor moment during the posttest MVC doublet was higher in HC compared to cLBP (12.4; SE, 1.5 versus 7.9; SE, 1.4 Nm, respectively; P = .051).

CONCLUSIONS: Differences in performance on the Sörensen test may be influenced by trunk mass, trunk length, and strength of the trunk extensor muscles. Thus, we examined TTF in both healthy controls (HC) and subjects with cLBP performing (1) a standard Sörensen test, and (2) a modified test that accounted for anthropometrics and trunk extensor strength.

NUMBER OF SUBJECTS: Fifteen subjects (8 cLBP, 7 HC) aged 18 to 45 years.

MATERIALS/METHODS: Sessions were separated by at least 72 hours. Subjects were positioned prone with iliac crests aligned with the edge of the table, pelvis secured to the table, and ankles secured using a T-bar with an embedded 1-DOF load cell. The trunk rested on a platform connected to a counterbalancing weight stack through a pulley system. A 6-DOF load cell fixed between the floor and the platform was used to assess trunk forces and moments. The eSTIM amplitude of peak twitch force was determined. Subjects performed 4 maximal voluntary contractions (MVC) of the trunk extensors during the first session; visual feedback of the extensor moment was considered to be maximal effort. For the standard Sörensen test session, only the weight of the platform was counter-balanced. For the modified test session, the counterweight load was set to 30% of the subjects’ maximal trunk extensor moment to maintain the horizontal position. The primary contributors of peak aGRF in increasing gait speed are trailing limb angle (TLA) and ankle plantarflexion moment (Ma) [4]. TLA represents the line between the center of pressure to the greater trochanter within the sagittal plane [3]. Additional gait abnormalities post THA include limited hip range of motion (ROM) and strength [5]. The purpose of this study was to assess how ROM and strength deficits are related to TLA after THA between 2 minimally invasive surgeries (MIS), the posterolateral (PL) and direct anterior (DA).
walking speed, TLA, peak aGRF, Ma, and ankle moment arm were produced in Visual3D Version 5. ROM with standard goniometer and manual muscle testing of bilateral lower extremities was performed by an experienced physical therapist. Pearson coefficient of correlation were done between TLA and hip extension ROM, hip abduction ROM, hip extension strength and hip abduction strength at Pre, 3, and 12 months on the surgical leg with pooled, PL, and DA group data, in SPSS 22 (IBM), alpha at .05.

RESULTS: No significant correlation existed between TLA and hip extension and abduction ROM. TLA and hip extension strength showed correlation at pre (r = 0.60, P < .01) and 3 months (r = 0.36, P < .05) in pooled data but only in pre between the PL (0.54, P < .05) and DA (0.63, P < .01) group. In pooled data, hip abduction strength showed correlation at all measurement time frames (pre: r = 0.40, P < .05; 3: r = 0.44, P < .01; 12: r = 0.46, P < .01). The PL group had correlation in hip abduction strength only at pre surgery (r = 0.41, P < .05) while the DA group at 3 (r = 0.50, P < .05) and 12 months (r = 0.55, P < .05).

CONCLUSIONS: Hip extension strength appears to affect TLA before surgery and in early rehabilitation but its effect is nonsignificant as healing continues. Hip abduction strength, usually considered controlling pelvic alignment in the frontal plane, also has an effect on movement in the sagittal plane by contributing to TLA throughout the healing continuum.

CLINICAL RELEVANCE: Focusing on hip extension and hip abduction strength in early rehabilitation may improve gait speed and improve functional mobility in individuals post-THA.

OP0183

CLINICAL MANAGEMENT OF CHRONIC UPPER QUADRANT PAIN: "TOP DOWN" VERSUS "BOTTOM UP" APPROACH: CASE STUDY
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BACKGROUND AND PURPOSE: A strict biomedical model is giving way to a deeper understanding of pain mechanisms including central sensitization and its management. This paradigm shift advocates clinicians address neuroplastic changes that may contribute to the condition via a “top down approach” in addition to focusing on biomedical pathology alone, “bottom up approach” (Priganc et al 2011). The purpose of this case report is to describe how a top down approach was incorporated in the management of chronic neck and shoulder pain.

CASE DESCRIPTION: A 43-year-old man with 5-year history of neck and shoulder pain, self-referred to physical therapy after being medically cleared via lab tests and imaging. Physical therapy initially took a bottom up approach, focusing on biomechanical impairments of ROM, strength and pain via manual therapy, neurodynamics, and therapeutic exercise. Since no significant functional or objective progression was seen after 4 weeks, the therapist hypothesized that impaired central processing of sensory information was relevant. The treatment focus was transitioned to a top down approach. During phase II the therapist utilized a Graded Motor Imagery program and Neuroscience Education for 8 weeks, resulting in meaningful improvements. In phase III, manual therapy and therapeutic exercise were reintroduced to address remaining physical impairments in a combined treatment approach. Patient was seen for 18 visits over 4 months.

OUTCOMES: Initially the Patient-Specific Functional Scale (PSFS) was rated as follows: working on a computer, 5/10 and reaching overhead, 0/10. The numeric pain-rating scale (NPRS) was constant 5/10. Range of motion (ROM) for shoulder abduction and flexion was 90° each. Following phase I, PSFS remained unchanged, NPRS was 3/10 and constant. Beginning with phase II, laterality recognition was tested with Recognise Online. Accuracy for the left was 60%; response time was 3.5 seconds. In phase II objective and functional measures began to improve. Latency accuracy improved to 67%; response time was 3.1 seconds, at discharge 90% accurate, 2.7-second response time. Abduction ROM progressed from 105° in phase I, to 160° in phase II and 180° at discharge. In phase II PSFS for computer work was rated 6/10, reaching overhead 8/10. At discharge NPRS improved to 0 to 3/10. PSFS was 8/10 for working on computer, 10/10 for reaching overhead.

DISCUSSION: For individuals with persistent pain, it is important to consider relevant pain mechanisms in terms of peripheral nociceptive input and central processing mechanisms. When treating this patient with a strictly physical dependency bases, or bottom up approach, there was no significant improvement in pain or function. Over the course of treatment with a change from a bottom up to a top down approach, significant improvement was seen in pain and function. The transition to consider both the biopsychosocial and central mechanisms as contributors to pain proved to be beneficial in treatment.


OP0184

A RETROSPECTIVE ANALYSIS OF THE PRESEASON SCREEN USED IN A PROFESSIONAL BALLET COMPANY, WITH RECOMMENDATIONS FOR IMPROVEMENTS IN THE SCREEN
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PURPOSE/HYPOTHESIS: The objectives were to determine if the current preseason screen used by the Nashville Ballet was identifying dancers at risk for injury, to determine the injury rates and patterns of injury within the company and to propose measurement tools to enhance the preseason screen.

NUMBER OF SUBJECTS: Past screen history from the 2007-2014 seasons was obtained from 285 medical records. Additionally, 17 professional dancers from the Nashville Ballet (11 female, 6 male) were assessed prior to the 2015 season.

MATERIALS/METHODS: Past screen history from the 2007-2014 seasons was obtained from 285 medical records. The ability of the established preseason screen to predict injury among the injured dancers was determined by noting side-to-side differences specifically in the manual muscle test and functional movement analysis portions of the screen. Additionally, 17 Nashville Ballet dancers from the 2015 season (11 female, 6 male) were included in the study. Strength was assessed by hand dynamometry on the gluteus maximus and gluteus medius muscles of each subject. Three-dimensional motion analysis of the dancers performing demi-plies on the right and left sides in parallel and in turnout were assessed. Paired-samples t-tests were run with a Bonferroni correction and significance was set at P<.05.

RESULTS: All injuries reported during the 2007-2014 seasons were in the lower extremity. Previous preseason screen data showed the manual mus-
The hallux valgus angle. An angle larger than 15° indicated hallux valgus. were divided into groups (controls, n = 10; hallux valgus, n = 19) based on measurement of MPD.

CONCLUSIONS: Professional ballet dancers are at an increased risk for lower extremity injuries because the current preseason screen used by professional ballet companies only identifies 25.64% of side-to-side differences. Adding more objective screening equipment such as the hand dynamometer and 3-D motion analysis is recommended to improve the preseason screen and to better identify dancers at risk for injury.

CLINICAL RELEVANCE: The current preseason screen that is used for professional ballet does not appear to be adequately identifying dancers who are at risk for injury. However, by adding more objective tests such as dynamic strength measurements of the gluteal muscles and 3-D analysis of common dance moves should improve the preseason screens to identify at risk performers.

OP0185
THREE-DIMENSIONAL METATARSAL PROTRUSION DISTANCE: A POTENTIAL RISK FACTOR FOR BUNION
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PURPOSE/HYPOTHESIS: First metatarsal protrusion distance (MPD) has been studied as contributing to bunion formation. A bunion (hallux valgus) is a deformity that presents as a lateral deviation of the hallux with a corresponding medial deviation of the first metatarsal. To date, the majority of investigations have used radiographic (2-D) methods, with most reporting a long first metatarsal as a characteristic of hallux valgus. This study measured MPD using a 3-D computer image reconstruction modeling process, testing the null hypothesis of no group difference in women with hallux valgus compared to controls.
NUMBER OF SUBJECTS: Twenty-nine women (mean ± SD age, 59 ± 17 years) were divided into groups (controls, n = 10; hallux valgus, n = 19) based on the hallux valgus angle. An angle larger than 15° indicated hallux valgus.
MATERIALS/METHODS: Magnetic resonance images of the foot were acquired prepared groups over time with significance set at P < .05.
RESULTS: There was a significant interaction (P = .002) for PCT. The experimental group had increased PCT and shoulder pain [3-6]. Considering that PCT and shoulder pain can result in significant functional limitations, studies evaluating the effectiveness of targeted treatment for PCT are needed. This study compared the effects of 2 interventions on PCT, IR and ER ROM, ER strength, pressure pain threshold (PPT), and subjective outcomes in individuals with shoulder pain and PCT.
NUMBER OF SUBJECTS: Fifty-two individuals with PCT and shoulder pain.
MATERIALS/METHODS: Subjects were randomized to 2 groups: experimental (mean ± SD age, 41.2 ± 12.8 years; weight, 78.8 ± 13.4 kg; height, 1.72 ± 0.09 m; 41.4 ± 53.3 months of pain) and sham (age, 40.1 ± 12.1 years; weight, 76.1 ± 15.8 kg; height, 1.69 ± 0.08 m; 42.4 ± 35.9 months of pain).
Self-reported shoulder pain was confirmed with a clinical examination [7,8]. PCT was determined by a difference between shoulders of at least 7° in the low flexion (LF) test [9]. IR and ER ROM was measured with a digital inclinometer at 90° of shoulder abduction with 90° elbow flexion. IR strength was measured with a handheld dynamometer. A blinded evaluator took each measurement twice. PPTs for the upper trapezius, infraspinatus, supraspinatus, deltoid, levator scapulae and tibialis anterior were assessed 3 times each with a digital algometer. Subjective outcomes were recorded using the SPADI. All variables were evaluated at pre- and posttreatment. The experimental protocol included GHJ posterior glide mobilization (5 minutes), sleeper stretching (3 × 30 seconds) and ER strengthening (3 × 10 repetitions). The sham group protocol included placebo ultrasound (5 minutes), upper trapezius stretching (3 × 30 seconds) and scapular retraction (3 × 10 repetitions). Both protocols were performed 3 times per week for 4 weeks. A mixed-model ANOVA compared groups over time with significance set at P < .05.
RESULTS: There was a significant interaction (P = .002) for PCT. The experimental group had increased PCT and shoulder pain [3-6] compared to the sham group (17.5° ± 1.0°) compared to the sham (17.5° ± 1.6°). There was a significant main effect of time for IR ROM, with increased IR ROM (4.5° ± 1.4°) at posttreatment. No significant effects were found for ER ROM or ER strength. PPTs increased significantly for upper trapezius, supraspinatus and deltoit at posttreatment for both groups. Both groups had significantly decreased pain and improved function posttreatment.
CONCLUSIONS: The experimental protocol was effective at improving PCT, while both protocols were effective in reducing pain and improving function, IR ROM and local pain sensitivity in individuals with shoulder pain and PCT.
CLINICAL RELEVANCE: Matching a treatment (GHJ mobilization) to a specific impairment (PCT) was more effective at improving motion than a nonspecific sham treatment, but not more effective for altering other outcomes. Possible reasons for this finding includes (1) natural recovery, (2) placebo effect from therapist interaction, (3) a real effect of shoulder movement in the sham protocol, and (4) the chronicity of symptoms.

OP0187
THE INTERNAL CONSISTENCY OF A MODIFIED VERSION OF THE LOWER EXTREMITY FUNCTIONAL SCALE FOR PATIENTS RECEIVING A TOTAL JOINT ARTHROPLASTY
James R. Rush, Thomas J. Curtis, Curt Bay, Randall J. Case,
We believe the instructions were improved to make it easier for patients ing sharp turns while running fast, hopping, and walking a mile, which oLEFS because items such as running on even and uneven ground, making sharp turns while running fast, hopping, and walking a mile were eliminated in the mLEFS; as these items may not be appropriate physical therapy goals for older adults at an outpatient facility. Wording changes were also made to the instructions to make it easier for patients to answer the questions without assistance. The total number of questions for the mLEFS was reduced from 20 in the original instrument to 15, with a maximum score of 60.

**NUMBER OF SUBJECTS:** This was a retrospective study of 66 patients through a systematic chart review.

**MATERIALS/METHODS:** Patients were included if the participant had undergone a total knee arthroplasty or a revision surgery. Patients also had to have completed the mLEFS a minimum of twice to be included in the study: once at initial examination and once at discharge. Cronbach’s alphas were calculated for both pretest and posttest of the mLEFS to estimate internal consistency of the scale. A dependent-samples t test was calculated to assess the significance of the difference between the pretest and posttest scores. An exploratory factor analysis was also conducted to assess the dimensionality of the revised scale.

**RESULTS:** The sample consisted of 40 females and 26 males. Average ± SD age of the patients was 69.77 ± 9.29 years. The average ± SD number of visits was 12.03 ± 4.54. The mean score for the pretest was while the mean score for the posttest was. The mLEFS posttest score was significantly higher (46.94 ± 8.66) than the pretest score (33.97 ± 12.46; P < .001). At the initial examination, Cronbach’s alpha was .93, which is considered high. For the posttest examination, Cronbach’s alpha was .89. Results of the exploratory factor analysis suggested the presence of at least 2 dimensions, 1 associated with activities of daily living, and the other with walking-related tasks.

**CONCLUSIONS:** The mLEFS exhibited high internal consistency and revealed a significant change in pretest to posttest administration; however it appears that this scale may be optimally interpreted using more than 1 scale score. Preliminary analysis of the mLEFS in patients with total joint arthroplasty suggests that this truncated scale may be more efficient and useful in this population than the oLEFS. Further investigation is ongoing.

**CLINICAL RELEVANCE:** We believe the mLEFS is an improvement on the oLEFS because items such as running on even and uneven ground, making sharp turns while running fast, hopping, and walking a mile, which are inappropriate for older adults recovering from total knee arthroplasty. We believe the instructions were improved to make it easier for patients to answer the questions without assistance.

**OPO188**

**Efficacy of Instrument-Assisted Soft Tissue Mobilization in Comparison to Gastrocnemius-Soleus Stretching for Dorsiflexion Range of Motion**

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**PURPOSE/HYPOTHESIS:** Limited dorsiflexion range of motion (DF ROM) is associated with numerous injuries that can alter or limit function [1]. Evidence supports stretching interventions to increase DF ROM [2]; however, limited research is available on the efficacy of Instrument-Assisted Soft Tissue Mobilization (IASTM). This study investigates IASTM and its impact on DF ROM in comparison to traditional stretching interventions.

**NUMBER OF SUBJECTS:** Sixty.

**MATERIALS/METHODS:** Utilizing a randomized controlled trial, participants were allocated to 1 of 3 groups: IASTM, stretching and control. The IASTM group received treatment for 2 minutes in a direction parallel to the muscle fibers [3]. The stretching group was instructed in a wall stretch with the knee extended and then flexed for 3 bouts of 30 seconds each. DF measurements were assessed before and after interventions to analyze immediate effects of interventions in weight bearing (WB) versus nonweight bearing (NWB) conditions. The outcome measures included the Weight Bearing Lunge Test (WBLT) using a digital inclinometer [4] as well as the Modified Root Position 1 (MRP1) with the knee extended at 0° and the Modified Root Position 2 (MRP2) with the knee flexed to 90° using a goniometer [5]. Paired t tests were conducted to evaluate within-group significance. Between-group comparisons were analyzed using 2-way analyses of variance (ANOVAs). Post hoc Tukey’s analyses were utilized to compare mean changes between the groups.

**RESULTS:** No significant differences in ROM were identified between groups at baseline. A group-by-time interaction revealed statistically significant changes in ankle DF in the WBLT (P = .01) and MRP2 (P = .031) favoring the stretching and IASTM groups. No significant changes were observed with the knee extended to 0° for all groups (P > .943). Specifically, a significant difference was identified with the IASTM intervention for both the WBLT (P = .018) and the MRP2 (P = .045) measures when compared to controls. Significant improvements were also found for the stretching group, however, only in the WBLT position (P = .034). No significant difference existed between the intervention groups. No within-group significant differences were identified in the control group.

**CONCLUSIONS:** IASTM produced a statistically significant increase in DF ROM in WB and NWB conditions compared to control as demonstrated with the WBLT and MRP2. Stretching revealed a statistically significant improvement in WB with the WBLT. It is possible to suggest that the soleus was attributed to the greatest influence on the increase in ROM based on significant results with the knee in flexed positions. The results also suggest that IASTM was more effective than stretching at improving ankle DF ROM in NWB conditions based on MRP2 measurements.

**CLINICAL RELEVANCE:** Foot and ankle pathologies are inherently associated with WB stresses and limited DF. Since IASTM and stretching both revealed significant increases in ROM with the WBLT, these interventions can be considered viable treatment options for increasing DF ROM.

**OPO189**

**THE USE OF PAIN NEUROSCIENCE EDUCATION IN OLDER ADULTS WITH CHRONIC BACK AND/OR LOWER EXTREMITY PAIN**

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**PURPOSE/HYPOTHESIS:** Chronic pain is highly prevalent among older adults and contributes to disability [1,2] and increased health service utilization [3]. Analogic options are limited due to high levels of comorbidity and the potential for adverse drug reactions [4]. Pain Neuroscience Education (PNE) has demonstrated effectiveness in reducing pain and improving pain self-efficacy in individuals under 60 years of age [5,6], but there is a paucity of research examining its use with older adults. If PNE has similar effects in older adults, it has the potential to be a useful nonpharmacological intervention for the older adult population. The purpose of this pilot project is to determine whether older adults with chronic pain conditions are receptive to PNE and to determine potential efficacy of this treatment in terms of pain intensity, kinesiophobia, and mobility.

**NUMBER OF SUBJECTS:** Twenty.

**MATERIALS/METHODS:** Twenty subjects, 9 female, aged 65 to 88 (mean age, 73 years) years, reporting low back and/or lower extremity pain on most days for at least 3 months attended 2 study sessions. The first session started with data collection including demographic information, Tampa
Subjects universally felt that the education would be helpful to people in pain and all 20 would recommend PNE to a friend in pain. There was a statically significant reduction in PDI (P = .001) and TSK (P = .002) scores after PNE. There were no changes in gait speed.

CONCLUSIONS: Adults over the age of 65 are able to understand PNE and find it useful. The educational sessions also show potential efficacy for reducing disability and kinesiophobia.

CLINICAL RELEVANCE: There is a high prevalence of chronic pain in adults over the age of 65. These results suggest that PNE may be an effective intervention for treating chronic pain in this population.

TREATMENT MODIFICATIONS IN THE PHYSICAL THERAPY MANAGEMENT OF A PATIENT WITH CHRONIC LOW BACK PAIN AND SIGNS AND SYMPTOMS OF CENTRALIZED PAIN: A CASE REPORT

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BACKGROUND AND PURPOSE: Central sensitization is believed to play a role in the transition from acute to chronic pain, as well as contribute to the sustainment of chronic pain. Signs and symptoms of centralized pain are hallmark characteristics of some chronic pain conditions including a subgroup of individuals with chronic low back pain necessitating treatment modifications. The purpose of this case report is to describe modifications to clinical practice guidelines in the physical therapy management of a patient with low back pain and signs and symptoms of centralized pain.

CASE DESCRIPTION: The patient was a 52-year-old woman who presented to physical therapy with a 5-month history of low back and left lower extremity pain. Her past medical history was significant for fibromyalgia, migraines, and irritable bowel syndrome. The patient completed the Central Sensitization Inventory during her initial visit and scored a 71/100. Her score on the Central Sensitization Inventory along with her past medical history of fibromyalgia, migraines, and irritable bowel syndrome suggested a centralized pain component to her clinical presentation. Furthermore, she scored a 20/24 on the Fear-Avoidance Beliefs physical activity subscale indicating a potentially poor prognosis for recovery. The patient was classified using the Orthopaedic Section of American Physical Therapy Association’s clinical practice guidelines into the categories of chronic LBP with movement coordination impairments and chronic LBP with generalized pain. Treatment was provided as directed by the guidelines. Important modifications included the use of pain neuroscience education, graded activity, graded exposure, and activity pacing. Additionally, a Transcutaneous Electrical Nerve Stimulation (TENS) unit was provided for use at home during functional activities as this has been shown to positively alter centralized pain.

OUTCOMES: Key outcomes included fear avoidance beliefs and activity as measured by a pedometer. The patient was seen for 3 physical therapy sessions over 6 weeks. Clinically meaningful improvements were observed in both physical activity and fear-avoidance beliefs.

DISCUSSION: This case describes clinically meaningful improvements in outcomes in a patient with chronic low back pain and signs of a centralized pain condition in whom modifications were made to a treatment approach guided by clinical practice guidelines.
THE CORRELATION BETWEEN PECTORALIS MINOR MUSCLE LENGTH AND ROTATOR CUFF STRENGTH USING A COMBINATION SQUARE AND BASELINE PUSH-PULL DYNAMOMETER

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PURPOSE/HYPOTHESIS: The chronically tight pectoralis minor muscle pulls the scapula into elevation and protraction by its attachment to the coracoid processes. This contributes to grossly altered shoulder girdle kinematics by directly interfering with scapular displacement and glenohumeral joint positioning which further interferes with the resting length-tension relationship of the rotator cuff musculature. The aim of this research is to determine whether a relationship between pectoralis minor length and rotator cuff strength exists. Our hypothesis is that a shortened pectoralis minor muscle is associated with decreased rotator cuff strength.

NUMBER OF SUBJECTS: Forty-six young healthy college students (25 male, 21 female) aged 26.4 ± 5.6 years.

MATERIALS/METHODS: Three researchers collected the data, and each was assigned to 1 specific component to measure consistently (researcher 1 measured pectoralis minor length, researcher 2 measured rotator cuff strength, and researcher 3 measured scapular displacement). The informed consent and demographic information were collected at the initial administration. A combination square was used to measure pectoralis minor length in standing with subject against the wall, from the anterior tip of the acromion to the wall. A Baseline handheld push-pull dynamometer was used to quantify strength of shoulder external rotators, internal rotators, and abductors. A standard tape measure was used to measure scapular displacement from midline to inferior angle at rest, 90° and 180° of scaption. Pearson product-moment correlation coefficient was used for data analysis.

RESULTS: The Pearson correlation coefficient at 95% confidence level between pectoralis minor length and shoulder internal and external rotator, and abductor strength showed a statistical significant moderate to strong positive correlations (r = 0.552, P < .01; r = 0.619, P < .01; r = 0.542, P < .01, respectively). Pectoralis minor length and scapular displacement at rest, 90°, and 180° also showed statistically significant weak to moderate positive correlations (r = 0.298, P < .01; r = 0.259, P < .01; r = 0.301, P < .01, respectively).

CONCLUSIONS: Results of this study show correlation of pectoralis minor length and the strength of the rotator cuff and scapular displacement. Assessing the pectoralis minor length as a component of shoulder evaluation may enhance clinical outcomes. We thus recommend that physical therapists consider a pectoralis minor assessment in the plan of care that intends to rehabilitate and strengthen rotator cuff musculature.

CLINICAL RELEVANCE: It is important to consider the dynamic role of pectoralis minor length in patients who demonstrate postural mal-alignment and shoulder rotator cuff problem. Restoring optimal pectoralis minor length will restore optimal kinematics of the shoulder girdle which will create better positioning for length-tension relationships of the rotator cuff musculature.

SOFT TISSUE MOBILIZATION VERSUS ECCENTRIC EXERCISE FOR THE TREATMENT OF TENDINOSIS

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PURPOSE/HYPOTHESIS: The purpose of this systematic review was to determine the effectiveness of soft tissue mobilization compared to eccentric exercise in the treatment of tendinosis in terms of pain reduction and functional outcomes.
number of subjects: not applicable.

materials/methods: a literature search (2006-2016) of cinahl, medline, web of science, science direct, and pubmed using the search terms: (tendinosis or tendinopathy) and (astym or eccentric exercise). selection criteria: rcts, human subjects, and english language. two reviewers independently assessed each article for methodological quality and came to consensus based on pedro scoring guidelines.

results: a total of 506 articles were screened for eligibility. following detailed appraisals, 7 rcts fulfilled criteria. pedro scores ranged from 6 to 9/10 (average, 7/3). samples ranged from 16 to 120 subjects (430 total) with chronic tendinopathy pathology in the shoulder, elbow, knee, and heel cord across all studies. ecc was performed for 3 sets of 15 repetitions for 1.67 times per day, 2 to 7 days per week, averaging 9.67 weeks duration (4-12 weeks). st was performed for 2.33 times per week averaging 9.33 weeks duration (4-12 weeks). primary outcomes included the dash, vis-a, and vas. no adverse events were reported. there were statistically significant between-group improvements noted in functional outcome measures (vis-a and dash) following ecc and st versus ecc alone in 2 studies. there were statistically significant between-group improvements noted in pain (vas) following ecc versus concentric exercise in 1 study. there were statistically significant improvements noted in functional outcome measures (vis-a) following ecc in 1 study. there were no statistically significant between-group improvements noted in functional outcome measures (vis-a) following ecc versus surgery in 1 study. there were no statistically significant between-group improvements noted in functional outcome measures (vis-a) following ecc versus heavy slow resistance in 1 study. there were no statistically significant between-group improvements noted in pain (vas) following st versus therapeutic exercise in 1 study.

conclusions: there is moderate to strong evidence in support of an interventional effect of ecc and st in adults with chronic tendinopathy. ecc and st together appear superior compared to other forms of treatment for improving functional outcomes in adults with chronic tendinopathy. effective treatment protocols use ecc, for 3 sets of 15 repetitions, and st 4 to 5 days per week for 9 weeks. implementing interventions consisting of ecc and st are safe and feasible methods for treating chronic tendinopathy.

clinical relevance: the outcomes for ecc and st together appear superior compared to other forms of treatment for improving functional outcomes in adults with chronic tendinopathy. effective treatment protocols use ecc, for 3 sets of 15 repetitions, and st 4 to 5 days per week for 9 weeks. implementing interventions consisting of ecc and st are safe and feasible methods for treating chronic tendinopathy.

op0195

clinical utility and reliability of core endurance assessment in a healthy, normative population

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purpose/hypothesis: the potential benefits of core endurance for the conservative management of spine and lower extremity conditions has been well established in the literature. these studies often limit their ability to describe a general population by selecting young, athletic individuals. further, proposed techniques often lack in reproducibility, clinical utility, and robust statistical findings. the purpose of this study was to collect normative core endurance data for healthy individuals of varied age, sex and activity levels. a secondary aim was to establish preliminary reliability data for quantification of core endurance.

number of subjects: one hundred sixteen.

materials/methods: all subjects completed a health intake form and sf-12 questionnaire prior to the study. subjects then completed a practice trial in a variety of positions, including prone, right, and left side planks. after proper form was briefly demonstrated, subjects completed each plank position to task failure. for each plank variation, 2 authors blinded to one another began a timer once the intended testing position was assumed. time was stopped as soon as any body part other than the feet or forearm(s) touched the mat.

results: mean core endurance was found to be 93 seconds in prone plank, 40.38 seconds in left side, and 41.41 seconds in right side plank. independent t tests revealed significant differences between sex, those with and without plank experience, and bmi of male versus female participants. no significant difference was observed for age, functional health, and exercise characteristics. interrater reliability was found to be strong among prone plank, left side plank, and right side plank positions.

conclusions: assessment of core endurance via prone and side planks was found to have high interrater reliability. additionally, there were found to be statistically significant differences in plank hold times across sexes, in those with prior plank exposure, and according to bmi. as identified in this study, plank hold times were lower in this population than in many published research studies: specifically when compared to those measuring plank hold time in higher-level athletes. clinicians should recognize this when assessing core endurance in a general population. data collected for a more heterogeneous population may better represent those persons most often seen in clinic, thereby optimizing clinical reasoning and decision making for clinicians.

clinical relevance: to the knowledge of the authors, this is the first study of normative data for prone and side planks in a population more representative of the typical adult population seeking outpatient therapy services. when aggregated with existing core endurance data, the findings from this study may assist in better describing normative core endurance in healthy individuals of varied activity levels. minimal detectable change as reported in this study may assist in appreciating the magnitude of change required to declare a true improvement in core endurance. future research to establish involved musculature in prone and side planks is indicated.

op0196

therapeutic management and complications in pediatric congenital femoral deficiency: a case report

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background and purpose: congenital abnormalities involving limb length discrepancy of the femur affect pediatric gross motor, neuromuscular, and social development. currently, multidisciplinary management is used to optimize function postnataally and into adolescence. however, therapeutic management is poorly reported and minimal research exists to guide best-practice therapeutic intervention. this case report identifies and describes the application of, and outcomes associated with, therapeutic management of pediatric congenital femoral deficiency in order to contribute to and promote further discourse to develop best-practice strategies toward managing this diagnosis from a physical, psychosocial, cognitive dimension as well as patient-family-empowerment related to self-care management.

case description: a 4-year-old girl presented for rehabilitation following limb lengthening with external fixator secondary to congenital femoral deficiency (cfd) with greater than 40° loss of knee extension limiting weight bearing, mobility, and ambulation. evaluation included neuromuscular (strength, range of motion, circumference, balance, gait, movement control) and integumentary (wound care) assessment, as well as communication with interdisciplinary care providers, pediatric surgeon, and family. intervention consisted of 6 weeks of soft tissue stretching and mobilization, joint mobilization, dyna-splint use, self-care management education, and creation and implementation of a "brave chart" for behavior modification and reinforcement.
OUTCOMES: Improved soft tissue and joint mobility, increased weight bearing functional use, and decreased emotional distress, combined with improved self-care management and brace compliance, were observed throughout the 6-week period. In particular, range of motion improved from greater than 40° loss of flexion to lacking only 6° from full extension. Functionally, ambulation was independent of wheeled walker at home and community distances.

DISCUSSION: Biopsychosocial consideration should occur within the rehabilitation environment to consider the multidimensional approach to managing CFD. Clear objective goals and outcome assessment should be provided to the patient, family, surgeon, and other interdiscipliary medical professionals. Additionally, patients in the pediatric population may require innovative encouragement and reinforcement for intervention compliance.

al. This approach allowed a patient, who was severely restricted at work and driving, to return to all functional activities with minimal limitations.


The outcome measures for this case study were the patient specific functional scale (PSFS), numeric pain rating scale and ability to participate in golf. The initial PSFS score was 3/30 with the 3 activities being walking, jogging and golf. The initial pain level was 3/10 at left lateral knee. Patient was restricted from sport at that time. Three months after surgery the patient had significant improvement to 27/30 on the PSFS, 0/10 pain and had progressed to chipping, putting in golf and jogging. Patient was slower than expected on meeting functional milestones due to excessive fear avoidance and decreased activity tolerance.

The number of visits necessary to optimally treat patellofemoral pain syndrome: A pilot study

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Purpose/hypothesis: As health care costs continue to escalate, payers are examining ways to reduce expenditures. As payment systems evolve under the Affordable Care Act, the ability to deliver value to the consumer and payers at the lowest cost is increasingly important. Ascertaining an expected number of treatment sessions to optimally treat patients in physical therapy is important information for all stakeholders including the patient, therapist, and payer. Additionally, severity of symptoms and psychological factors have been found to predict clinical outcomes, and the relevance of these factors for optimal duration of care should be assessed. Conventionally, patellofemoral pain syndrome is treated with 8 to 12 visits; however, to the authors’ knowledge no evidence supports this number of treatments. The aim of this pilot study is to determine the optimal number of sessions necessary to effectively treat patients with patellofemoral pain syndrome.

Number of subjects: Fifty-six patients (mean ± SD age, 45.38 ± 1.59 years; 40 (71.4%) female) with patellofemoral pain were included in this pilot study.

Materials/methods: The pilot data were pulled from completed cases in 2 research studies assessing physical therapy and patellofemoral pain syndrome. To establish the appropriate number of visits, we determined the number of sessions necessary to achieve maximum clinical significance functional improvement on the Anterior Knee Pain Scale. The minimal clinically important difference was considered 10 points [6]. To determine if severity of the condition was a factor, we assessed the effect of duration of symptoms, initial functional level, and fear avoidance beliefs. The mean number of sessions was calculated for the number of visits necessary to achieve maximal functional improvement to determine the appropriate number.

Results: Of the 56 patients, 41 (73.2%) experienced a clinically significant improvement in function. In the patients who achieved significant functional improvement, the mean number of sessions necessary to achieve a maximal clinically significant improvement was 6.3 visits (95% CI: 5.5, 7.2). Severity of condition did not have a significant effect on the number of sessions necessary to achieve maximal functional improvement (duration of symptoms, P = .80; initial functional level, P = .07; and fear-avoidance beliefs, P = .29).

Conclusions: Most patients achieved maximal functional improvement sooner than the 8 to 12 visits traditionally prescribed to treat patellofemoral pain syndrome. The results of this pilot data suggest that regardless of the severity of the condition, 6 visits may provide the greatest value for the least cost when treating patellofemoral pain syndrome. Additional research is necessary to substantiate the findings of this pilot work.

Clinical relevance: Fewer visits may result in the greater value for the physical therapy care of patients with PFPS.

OP0202

A PORTABLE BRAKE SIMULATOR PROVIDES FEEDBACK ON REACTION TIME FOR A PATIENT WITH A BRAIN INJURY AND TOTAL HIP ARTHROPLASTY

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Purpose: Describe the use of a newly developed portable brake simulator (DriveSim; not yet in production) that provided information on visual reaction time and directed the focus of patient care after total hip arthroplasty (THA) complicated by brain injury.

Description: Case study of a 67-year-old man was seen 9 weeks after a motor vehicle accident (MVA) causing: subarachnoid diverticula (SAD), subdural hematomas in the frontal and temporal lobes, L clavicular fracture, L distal radial/ulnar fracture, nondisplaced C2 fracture, and R acetabular/femoral fracture with posterior hip dislocation. As a result of the trauma to his R lower extremity, he required a THA. After 30 visits to outpatient PT (13 weeks post-R THA), the patient was returning to his surgeon to discuss being medically cleared to drive. He reported having diminished confidence in his ability to return to driving if cleared by his physician.

Summary of use: The patient completed DriveSim testing which replicates an accelerator-to-brake pedal transfer with the R lower extremity. Protocol for DriveSim: patient is seated with R lower extremity, 150 ± 200 N of force (National Highway Safety Bureau standard force for almost all driving activities). Random and variable practice over 5 treatments: ball toss and kicking obstacle courses altered every treatment with visual cues for changes in gait speed and direction, balance tasks with vertical/lateral head movements visual cues; no direct practice of break simulation. At his 36th visit (17 weeks post-THA) the DriveSim was repeated (5 trials); visual reaction time (0.378 ± 0.038 seconds), total time (0.772 seconds). Force was met but activities to improve visual reaction time were included in his care to assist with his confidence and return to driving. Random and variable practice over 5 treatments: ball toss and kicking obstacle courses altered every treatment with visual cues for changes in gait speed and direction, balance tasks with vertical/lateral head movements visual cues; no direct practice of break simulation. At his 36th visit (17 weeks post-THA) the DriveSim was repeated (5 trials); visual reaction time (0.378 ± 0.038 seconds), total time (0.772 ± 0.044 seconds). Patient was medically cleared to return to driving by his physician and resumed all driving activities.

Importance to members: This newly developed portable brake simulator can provide therapists with objective data on: visual reaction to visual stimuli, accelerator-to-brake limb transfer times, and time to generate 200 N of force. Such information could assist with altering a clinician’s plan of care to improve a patient’s confidence and ability to drive.

OP0203

Shoulder treatment improves neck function and symptoms after multiple failed cervical surgeries

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Background and purpose: Describe a case of chronic neck pain and diminished function unresolved after multiple surgical procedures. Both pain and function improved with treatment directed at shoulder range of motion and strength.
Combined Sections Meeting

CASE DESCRIPTION: A 65-year-old man 5 weeks after a cervical extensor resection and realignment for chronic neck pain. Past surgical history: greater than 30 orthopaedic surgeries of multiple body regions, multiple cervical fusions and revisions due to infection (most recent: 2 years prior to evaluation, posterior cervical fusion C2-T2), multilevel lumbar fusions with multiple revisions, and 2 rotator cuff repairs on each shoulder (none within the last 10 years). Postoperative restrictions from his most recent procedure included no lifting greater than 10 lb. Chief complaint: cervical and upper trapezius pain (best, current, worst: 5/10, 3/10, 8/10) (same as before surgery), as well as difficulty with any form of reaching or lifting overhead which increases symptoms. Data: Limited cervical ROM, diminished function (Neck Disability Index [NDI], 65%; DASH, 61.6%; FABQ-PA, 17/24; Patient-Specific Functional Scale [PSFS], average, 4.66 [driving, standing, sitting]; 6-minute walk test, 1605 ft; UE weakness (glenohumeral HHD), flexion R, 21.2 lb; L, 15.4 lb; abduction R, 19.0 lb; L, 11.9 lb; ER R, 28.7°; L, 19.0°; IR R, 27.9°; L, 16.5°; scapular MMT rhomboids: 3/5 B, middle trapezius 3/5 B, lower trapezius 3/5 B; restrictions in shoulder ROM (AROM flexion R, 135° pain L, 130°; pain abduction R, 120°; pain L, 125° pain PROM ER R, 70°, L, 63° pain); restrictions in shoulder mobility (bilateral hypo inferior/posterior); MD referred the patient to physical therapy for scar mobilization, ultrasound and modalities only received clearance after 7 visits and added: shoulder mobilizations, AAROM, Thera-Band and dumbbell strengthening for 6 visits (10 weeks). Patient educated on a walking program to address deficits noted in 6-minute walk test.

OUTCOMES: At discharge (13 visits, 14 weeks total) pain free reaching overhead and diminished pain at baseline (best, current, worst, 0/10, 0/10, 3/10). Improved function (NDI, 46% ± 15.6%, DASH, 30.8% ± 30.8%, PSFS (8.33 ± 6.7), FABQ-PA (8 ± 9/24), 6-minute walk test (1850 ± 245 ft); improved UE strength (shoulder HHD flexion R, 35.3%; L, 81.8% abduction (R, 27.8%; L, 100.8%); ER (R, no improvement; L, 53.1%); IR (20.7%; L, 102.4%); scapular MMT rhomboids (4/5); middle trapezius (4/5 B); lower trapezius (3+5 B); improved shoulder ROM (AROM flexion R, 35°–40°); abduction (R, 20°; L, 43°); PROM from baseline (ER R, 6°; L, 3.2°).

DISCUSSION: An impairment based approach identified potential contributors to symptoms previously nonresponsive to surgical interventions. Comprehensive examination and treatment of impairments should be considered even in long standing conditions. Improvements in functional mobility, shoulder ROM and strength resulted in resolution of cervical pain and increased function.


RELIABILITY OF ULTRASOUND MEASUREMENTS OF ROTATOR CUFF MUSCLE CROSS-SECTIONAL AREA IN HEALTHY ADULTS

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PURPOSE/HYPOTHESIS: Muscle atrophy has been reported in patients with rotator cuff pathology [1]. Presumably, exercise yields positive changes in muscle structure which may be associated with improved strength and function, though this has not been well-studied. Ultrasound (US) imaging has been used extensively for examining shoulder pathology [2]. However, reliability of shoulder muscle size measurement with US is not well established. A few studies have reported variable reliability, 0.45 to 0.88, of rotator cuff muscle size using US [3,4,5]. Further, the relationship between muscle cross-sectional area (CSA) and torque measures is not known. The aim of this study was to establish the reliability of shoulder muscle CSA using US, examine side-to-side differences and to determine the relationship between size and torque.

NUMBER OF SUBJECTS: Nineteen asymptomatic, healthy adults (mean ± SD age, 30.8 ± 11.8 years; 12 male, 7 female; dominant arm: 19 right, 0 left).

MATERIALS/METHODS: Supraspinatus and infraspinatus muscle CSA of both shoulders was obtained using US. Multiple scans were performed a mean of 1.9 days apart to establish the intersession reliability. Supraspinatus images were captured in the transverse view at the suprascapular notch identified with the US with subject in a seated position and arm resting on a pillow. The infraspinatus muscle CSA was determined with subject in prone position. Using bony landmarks and a custom made template to standardize the measurement location, serial images of the muscle were obtained and spliced to calculate the CSA. Three scans were performed at each session and averaged. Size measurements (cm²) were then performed using ImageJ analysis. Abduction and external rotation torque (normalized to body weight) was calculated using force measures from a handheld dynamometer and moment arm length.

RESULTS: The ICC, SEM, and MDC values for the between-session reliability for muscle size measurements were as follows: supraspinatus ICC = 0.97; 95% CI: 0.93, 0.99; SEM, 0.3; MDC, 0.8; and infraspinatus ICC = 0.95; 95% CI: 0.86, 0.98; SEM, 1.3; MDC, 3.1. The supraspinatus and infraspinatus mean CSA were not different between the arms (supraspinatus: right, 7.3 ± 1.7; left, 6.9 ± 1.5; infraspinatus: right, 16.5 ± 5.7; left, 14.3 ± 5.5). The abduction torque and external rotation torque were not strongly related to the muscle size measurements (range of r values = 0.18-0.37).

CONCLUSIONS: The results of this study show excellent reliability for supraspinatus and infraspinatus muscle CSA measurements. There was no difference in the muscle CSA between arms. Correlation between muscle size and torque was not strong. These results need to be further validated in a larger sample size. Future steps include examining the change in muscle size in response to an exercise program.

CLINICAL RELEVANCE: Understanding mechanisms associated with pathology and response to exercise is important to guide practice. Muscle size represents a key variable and US offers a feasible and reliable measurement method. Further examination of the relationship between muscle size changes, and functional changes is warranted.
(1) healthy long-distance runners will display a consistent kinematic pattern of the trunk during running and (2) long-distance runners with a history of LBP will display varied pelvic and spinal kinematics compared to healthy controls.

NUMBER OF SUBJECTS: Ten long-distance runners (8 healthy and 2 with a history of LBP).

MATERIALS/METHODS: Runners between the ages of 20 and 40 years and who run at least 20 km (approximately 12 mi) a week were eligible. Subjects were excluded if they had current LBP, a neurological impairment, a severe structural back deformity, history of back or lower extremity surgery, were pregnant, or answered “yes” on the PAR-Q questionnaire. Motion capture biomarkers were placed on standard bony landmarks of trunk and pelvic to record 3-D joint range of motion during standing and during a 5-minute run on a treadmill. A Matlab software program was used to analyze joint angles.

RESULTS: Based on observation, healthy runners have a consistent pattern of trunk and hip kinematics during the running trial. Initial data analysis of trunk and pelvic ROM shows no clinical differences between healthy subjects and those with a history of LBP, although subjects with history of LBP have greater anterior pelvic tilt motion (healthy, 13.3 ± 1.6°; LBP, 17.2 ± 7.6°). More data collection on participants with a history of LBP is underway.

CONCLUSIONS: This pilot project has identified trunk and pelvic motion during running between a cohort of healthy runners and 2 runners with a history of LBP. Observational data revealed that the healthy runners display a consistent kinematic pattern in their trunk and pelvic compared to an inconsistent pattern displayed by the runners with a history of LBP.

CLINICAL RELEVANCE: Our findings may contribute to the understanding of the causes of LBP in runners and to the development of rehabilitation programs for runners with a history of LBP.

OP0207

FLEXOR HALLUCIS LONGUS ACTIVATION IN A DANCER’S MODIFIED HEEL RAISE: PRELIMINARY RESULTS

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PURPOSE/HYPOTHESIS: Flexor hallucis longus (FHL) tendinopathy is highly prevalent in female ballet dancers and is related to overuse. A “modified heel raise,” where the foot is placed on the edge of a block so that the toes are unsupported, was introduced as a potential intervention to reduce demand on the FHL. It was reported in our previous study that healthy dancers were able to perform fewer repetitions than nondancers during the modified heel raise fatigue task. However, no electromyographic comparisons have been made between traditional and modified heel raises. Therefore, the aim of this study was to compare muscle activation of the FHL along with the other larger, superficial plantarflexors during traditional and modified heel raises in a healthy dancer. Our hypothesis was that muscle activation of the FHL will be lower in the modified heel raise condition.

NUMBER OF SUBJECTS: One.

MATERIALS/METHODS: One healthy female dancer was instrumented with fine-wire electromyography (EMG) of the FHL, soleus, and lateral gastrocnemius and performed traditional and modified heel raises at a rate of 30 bm. The peak FHL activation was identified in the rectified EMG signals, and the activation ratio between FHL and lateral gastrocnemius and soleus was computed using integrated EMG data. Between-repetition variability of the EMG signals was visually analyzed.

RESULTS: Analysis revealed higher peak FHL activation, greater FHL/lateral gastrocnemius activation ratio, and greater FHL/soleus activation ratio in the modified heel raise condition. The FHL had greater between-repetition variability during modified heel raise, while the lateral gastrocnemius and soleus had greater variability during traditional heel raise. Kinematic data showed greater toe extension during heel contact in the modified heel raise, which suggested toe extensor cocontraction.

CONCLUSIONS: These findings are contrary to our hypothesis, suggesting that the modified heel raise leads to greater FHL activation compared to traditional heel raise in 1 healthy dancer, but visual inspection of between-repetition EMG variability may tell a contradicting story. Future research will include toe extensors activation and EMG variability as outcome measures, and include healthy nondancers as well as dancers with FHL tendinopathy as target populations.

CLINICAL RELEVANCE: This research is a part of an ongoing funded study that aims to investigate a novel intervention for FHL tendinopathy. The...
modified heel raise is currently being reviewed as 1 potential prevention or nonsurgical intervention strategy that could benefit populations at risk of, or suffering from, FHL tendinopathy.

OP0208
SCAPULAR AND CERVICAL NEUROMUSCULAR CONTROL DEFICITS IN MUSICIANS WITH PROLONGED UPPER-QUARTER PAIN: A CASE-CONTROL STUDY
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BACKGROUND AND PURPOSE: The purpose of this case report is to describe the importance of evaluating scapular mechanics in a patient following an injury to the shoulder. The patient presented with shoulder pain, numbness, and tingling.

RESULTS: The patient came in for 6 appointments over 4 weeks. DASH improved from 30 at the initial evaluation to 0 at time of discharge. Scapular elevation and upward rotation improved, enabling him to reach back to don jackets, reach overhead, return to a gym routine and perform all of his activities without pain.

DISCUSSION: Many patients have scapular mechanics that contribute to shoulder pain. The patient's scapular mechanics were evaluated and corrected, leading to improved shoulder function.


OP0209
IMPORTANCE OF EVALUATING SCAPULAR MECHANICS IN PATIENTS FOLLOWING STERNAL PRECAUTIONS
Elizabeth Sinish
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BACKGROUND AND PURPOSE: The purpose of this case report is to describe the importance of evaluating scapular mechanics in a patient following an injury to the shoulder. The patient presented with shoulder pain, numbness, and tingling.

RESULTS: The patient came in for 6 appointments over 4 weeks. DASH improved from 30 at the initial evaluation to 0 at time of discharge. Scapular elevation and upward rotation improved, enabling him to reach back to don jackets, reach overhead, return to a gym routine and perform all of his activities without pain.

DISCUSSION: Many patients have scapular mechanics that contribute to shoulder pain. The patient's scapular mechanics were evaluated and corrected, leading to improved shoulder function.

OP0210
TIMED UP AND GO IS MOST PREDICTIVE OF PATIENT-REPORTED OUTCOMES MEASUREMENT INFORMATION SYSTEM SCORE IN INDIVIDUALS Awaiting TOTAL KNEE ARTHROPLASTY
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PURPOSE/HYPOTHESIS: The Patient-Reported Outcomes Measurement Information System (PROMIS) computerized adaptive testing (CAT) physical function domain has the potential to quickly assess self-reported function before and after total knee arthroplasty (TKA). The timed up and go (TUG) test is commonly used in clinical practice but administration may be hindered due to space and patient limitations. PROMIS CAT has the potential to address these limitations but we lack evidence if TUG as well as other health indicators are predictors of PROMIS CAT.

The purpose was to assess whether TUG, body mass index (BMI), numeric pain-rating scale (NPRS), and smoking status are predictors of physical function, as measured by the PROMIS CAT, in candidates for TKA surgery.

NUMBER OF SUBJECTS: Sixty-five (40 female; mean ± SD age, 62.6 ± 8.9 years; height, 167.7 ± 9.4 cm; weight, 91.7 ± 17.0 kg).

MATERIALS/METHODS: Participants presenting to the University Orthopaedic Clinic with a diagnosis of severe knee osteoarthritis (OA) were offered the option of TKA by an orthopaedic surgeon. The PROMIS CAT physical function domain score, TUG, NPRS, BMI, and smoking status were collected on enrollment in the clinical trial. Multiple linear regression analyses were performed to determine the strongest predictors of PROMIS CAT (P < .05).

RESULTS: Smoking status did not affect the relationship between any of the variables and PROMIS CAT. The multiple regression analyses indicated that the TUG test was the best predictor of PROMIS score. BMI and NPRS did not incrementally help predict the PROMIS score beyond the TUG test. PROMIS CAT physical function domain scores had a moderate, negative correlation with the TUG test (r = –0.43; 95% CI: –0.61, –0.19; P < .0001) and a weak, negative correlation with NPRS (r = –0.30; 95% CI: –0.51, –0.05; P = .0102).

CONCLUSIONS: The relationship between PROMIS CAT physical function and the TUG test suggests that the PROMIS is not a surrogate for this functional performance measure in candidates for TKA. However, the TUG test was the best predictor of PROMIS physical function score compared to BMI, NPRS, and smoking status.

CLINICAL RELEVANCE: Clinicians should consider utilizing a variety of self-report and functional outcome measures to adequately assess patients with severe knee OA who are candidates for TKA surgery.

OP0211
RELIABILITY AND VALIDITY OF A SMARTPHONE WITH COMPASS APP FOR MEASURING TRANSVERSE PLANE MOTION
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PURPOSE/HYPOTHESIS: A therapist’s ability to accurately assess a patient’s range of motion (ROM) is a key component of the physical examination. In order for this information to be useful, it is necessary that it is accurate, reliable and valid. There are several tools on the market that can assess joint ROM, including the universal goniometer, electronic inclinometers, and digital inclinometers, among others. The iPhone is a commonly used smartphone with many applications (apps) available for potential use in measuring joint angles and ROM. If found to be reliable and valid, the iPhone could be an alternate and possibly more assessable tool to use for goniometry. Several apps have been found reliable in measuring motion in the sagittal and coronal planes, but none to date have been found reliable in the transverse plane. The purpose of this study was to test the reliability and validity of the iPhone 6s IOS compass application compared to the gold standard goniometer for measurements in the transverse plane. We hypothesize that the iPhone 6s IOS compass application will not be as valid as the goniometer for transverse plane measurements.

NUMBER OF SUBJECTS: Thirty.

MATERIALS/METHODS: Four Doctorate of Physical Therapy students acted as raters to measure the 30 randomly selected angles generated by using a protractor widget in whiteboard software which were then verified via “gold standard” steel protractor. The raters measured the 30 angles using an iPhone 6s IOS compass software application. Measurements were taken by each rater three times for each angle using different rooms and positions. We calculated the absolute value (AV) of the difference between the actual and measured angles and across repetitions.

RESULTS: Across all raters, the mean AV of the difference between the first and second measures ranged from 22.1 to 45.6 (all, P < .05). The difference between the actual angle and both first and second measures varied widely across all raters. Example: rater 1, measure 1 = 0.7 (P = .001); measure 2 = 38.2 (P < .0001). The mean AV of the difference between actual angle and measured angle varied from 0.7 to 44.1. The difference was greater for the first measure for some raters and greater for the second measure for others.

CONCLUSIONS: The “Compass” software application for this smartphone was found to be unreliable and subsequently invalid in measuring fixed angles in the transverse plane due to the instruments inability to maintain a stable true north.

CLINICAL RELEVANCE: The results of this study indicate that the specific software and device tested should not be used for clinical goniometry.

OP0212
ACHILLES TENDINOPATHY OCCURS ACROSS THE AGE SPAN AND AFFECTS QUALITY OF LIFE
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PURPOSE/HYPOTHESIS: Achilles tendinopathy is often described as a sports injury occurring mainly in runners; however, 1 recent Dutch study reported that only 35% of the patients with Achilles tendinopathy seeking help from a general practitioner were sports related [1]. Given the large number of nonathletes with Achilles tendinopathy, there is a need to better understand the condition’s health impacts in a general population. The purpose of this study was to examine individual and injury-specific factors, along with health-related outcomes in patients with Achilles tendinopathy [2].

NUMBER OF SUBJECTS: All subjects (n = 53, 29 male) included in a larger prospective study on Achilles tendinopathy between November 13, 2014 and April 6, 2016 were included.

MATERIALS/METHODS: Subjects completed questionnaires regarding their past medical history, current Achilles tendon injury and physical activity level. Outcome measures used were the Victorian Institute of Sport Assessment-Achilles (VISA-A), the Foot and Ankle Outcome Score-Quality of Life subscale (FAOS-QOL), the Pain Catastrophizing Scale (PCS), and the Tampa Scale of Kinesiophobia (TSK) [3-7]. Lower extremity function was assessed using the single-leg heel rise test.

RESULTS: The mean ± SD (range) age was 48 ± 16 years (19-79 years). Age
CONTRACTIONS ON PAIN SENSITIVITY OVER THE ACHILLES TENDON

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PURPOSE/HYPOTHESIS: There is mixed evidence on the superiority of eccentric-only exercise in reducing pain in chronic tendinopathies. The purpose of this study was to investigate the effects of plantarflexion exercise (eccentric, concentric, or isometric) on pain sensitivity measures over the Achilles tendon. We hypothesized that there will be no between-group differences in the effects on pain sensitivity when contraction duration is equivalent across groups.

NUMBER OF SUBJECTS: Sixty-nine adults were screened and 42 were found eligible (mean ± SD age, 24.6 ± 2.8 years) and block-randomized by sex into eccentric (ECC), concentric (CON), or isometric (ISOM) groups.

MATERIALS/METHODS: After eligibility screening and consent, subjects completed a series of questionnaires on pain and anxiety. Participants had their dominant side Achilles tendon assessed for pressure pain threshold (PPT) with a digital algometer, and heat pain threshold (HTP) and heat temporal summation (HTS) assessed with a computer-controlled thermode at 2 cm proximal to calcaneal insertion. The study timeline was as follows: Baseline 1, 48-hour washout, Baseline 2, 1-week intervention, and next day Postintervention assessment. After the Baseline 2 assessment, participants were instructed in specific exercise according to group assignment: CON, ECC, or ISOM plantarflexion contractions. One investigator observed and gave feedback during their first 3 sets of 15 repetitions of exercise. All contraction durations were to last 5 seconds and subjects were asked to complete 3 sets of 15 repetitions 2 times a day for 7 days.

RESULTS: There were no differences between groups on pain and anxiety questionnaires and for exercise compliance (P > .05). Excluded participants were mostly male due to not meeting a HPT of less than or equal to 46.3°C. Sex breakdown per group was: CON, 8 female, 6 male; ECC, 8 female, 5 male; ISOM, 8 female, 6 male. Preliminary analysis was performed by calculating absolute and standardized effect sizes of the change scores (postintervention minus the average baseline) for PPT, HPT, and HTS. HPT increased in CON by 2.04°C (95% CI: 1.21°C, 2.86°C; η² = 1.09), ECC by 1.39°C (95% CI: 0.60°C, 2.19°C; η² = 0.79), and ISOM by 2.45°C (95% CI: 1.39°C, 3.51°C; η² = 1.17). HTS decreased in CON by 5.09 mm (95% CI: 6.10, -16.27 mm; η² = 0.28), ECC by 12.50 mm (95% CI: -13.55, -11.35 mm; η² = -0.19), and ISOM by 7.39 mm (95% CI: -2.23, -12.56 mm; η² = -0.33). There was no consistent change in PPT across groups. Data collection will continue to include 10 females and males in each treatment group as per prior sample-size estimation.

CONCLUSIONS: Preliminary analysis showed that after 1 week of exercise, all treatment groups similarly reduced pain sensitivity for HPT, and ISOM and ECC groups also reduced HTS consistently. The changes observed in pain sensitivity support the use of long (5 seconds) duration contractions to create hypealgesia and de-emphasize contraction type.

CLINICAL RELEVANCE: Contraction duration, not contraction type, may be an important variable that impacts hypealgesic effects of exercise.
OP0215

RETURN TO OVERHEAD SPORT FOLLOWING ULNAR COLLATERAL LIGAMENT INJURY: A SYSTEMATIC REVIEW
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PURPOSE/HYPOTHESIS: Ulnar Collateral Ligament (UCL) injuries are common amongst overhead athletes of all ages. Twenty-five percent of major league pitchers report a history of UCL reconstruction. Surgical treatments for UCL injuries have increased over the past 2 decades. The goal of this systematic review was to examine the RTP rate as well as the return to same level of play or higher (RTSLP) rate of athletes after UCL injuries.

NUMBER OF SUBJECTS: Twenty-five studies, subjects followed up/enrolled (2288/3030) (2289 elbows).

MATERIALS/METHODS: A computer-assisted search of PubMed, CINAHL, Embase and SportDiscus databases was utilized, searching for articles from 1999 until December 2015. Studies prior to 1999 were not included due to consensus reporting of significant changes in surgical technique. The search utilized key terminology associated with ulnar collateral ligament reconstruction, revision, or repair in overhead athletes. This systematic review was designed based on the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses. Methodological quality of the individual studies was assessed using a modified Downs and Black checklist.

RESULTS: The search resulted in 421 abstracts, which was narrowed down to 25 research articles. Downs and Black scores of the articles revealed 2 high quality and 4 moderate quality. The remaining 19 articles rated in the low quality category. Overall RTP rate after UCL injury was 85.7% (range, 42%-100%). The average overall RTSLP rate was 81%. Only 28% of the articles included pitching performance. 86% of these showed significant decrease in innings pitched, 71% showed an increased trend in ERA, and 57% showed an increase trend in WHIP.

CONCLUSIONS: Low quality studies demonstrate a high RTP and RTSLP post UCL injury. Unfortunately, significant variability in reporting of data and a lack of a standardized definition for returning to play after UCL injury exists in these studies. Therefore, the actual benefit of UCL surgery and the true potential outcomes for an athlete who dam-

OP0216

THE EFFECT OF A WEIGHT-BEARING WINDLASS TEST ON DORSAL ARCH HEIGHT IN HEALTHY AND PATHOLOGICAL FEET
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PURPOSE/HYPOTHESIS: The mobility and support of the medial longitudinal arch is important in managing patients with foot and ankle pathology. The windlass function of the plantar fascia provides a mechanism of medial arch support and power generation. The Windlass Test has been used in diagnosing plantar fasciitis, but its sensitivity is low. Clinical measures assessing the effect of the plantar fascia on midfoot mobility are lacking.

The purpose of this pilot study was to examine the effects of a weight bearing Windlass Test (WBWT) on midfoot mobility using the dorsal arch height (DAH) measure in pathological and healthy feet.

NUMBER OF SUBJECTS: Sixteen subjects (mean age, 32.2 years; BMI, 24.3 kg/m²; 81% female) with a history of unilateral foot/ankle pathology consented to participate in the study. Foot and ankle pathology included a range of pathologies and chronicity, including foot fractures, heel pain, ankle sprain, and plantar fasciitis.

MATERIALS/METHODS: Subjects were placed in a standardized bilateral stance position. A digital gauge (Mitutoyo Corporation, Japan) placed at 50% of the total foot length was used by a blinded examiner to measure DAH (mm) in resting stance position and during the WBWT. Three measures were recorded for each foot. Intertrial reliability across 3 trials was assessed with intraclass correlation coefficients (ICC model 3,1). Paired t tests, applied to the mean of 3 trials, were used to examine group differences in DAH change between healthy and pathological feet.

RESULTS: Intertrial reliability was good (ICC = 0.79). DAH change was not significantly different between healthy feet and pathologic feet (mean ± SD healthy, 4.4 ± 1.2 mm versus pathologic, 4.3 ± 2.3 mm; P = .89). The range of DAH change scores across both feet was 1.6 to 9.6 mm.

CONCLUSIONS: The DH in the midfoot motion during the WBWT was smaller than ranges reported in the literature for the Navicular Drop Test. No difference in DAH during the WBWT between groups was found, but may be explained by study limitations.

CLINICAL RELEVANCE: Midfoot mobility during the WBWT is small and may not reflect overall midfoot motion, but may reflect the specific function of the plantar fascia. Future research is needed to determine the utility of the WBWT in examining plantar fascia function.

OP0217

A COMPARISON OF INTRINSIC FOOT STRENGTH IN PATHOLOGICAL AND HEALTHY FEET: A PILOT STUDY
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PURPOSE/HYPOTHESIS: Intrinsic foot muscle weakness has been implicated in a range of foot deformities and disorders. However, an objective measure of the relationship between muscle weakness and foot pathology has not been established. The purpose of the present study was to compare intrinsic foot strength between pathological and healthy feet using a Foot-Strength Test Device (US Patent Application number 15/689,550).

NUMBER OF SUBJECTS: Sixteen subjects (mean age, 32.2 years; 81% female) with a history of unilateral foot/ankle pathology consented to participate in the study. Reported pathology included: fracture (3), ankle sprain (5), tendinopathy/tendinitis (3), plantar fasciitis (3), and other (2).

MATERIALS/METHODS: Subjects were randomly assigned to side and position (seated or standing) testing order. Foot strength was measured with a Foot-Strength Test Device (US Patent Application number 15/689,550). After completing 3 practice trials, subjects pulled on a towel attached to a dynamometer by curling their toes. Peak force (lb) was recorded. Three trials were performed on each foot in both standing and seated positions, and the mean of the 3 trials used for data analysis. Paired t tests were used to examine group differences in foot intrinsic muscle strength, and for differences in position (sitting versus standing) with a priori alpha level of .05.

RESULTS: Mean ± SD strength values were: pathological sitting, 2.03 ± 0.96 lb and standing, 3.28 ± 1.02 lb; healthy sitting, 2.19 ± 1.28 lb and standing, 3.55 ± 1.32 lb. No differences in strength between pathological and healthy feet in sitting or standing were found. However, a trend of greater strength of the healthy foot was observed. Differences in strength between standing and seated positions were found (P<.05).

CONCLUSIONS: No difference in intrinsic foot strength between pathological and healthy feet was found, but may be explained by study limitations.
of sample size and varied pathology. A trend of greater strength on the healthy side was observed and warrants further research. Position was found to affect foot strength, with greater force production found in a standing versus seated position. Future research examining how position and specific pathology affect foot muscle strength may improve intervention planning.

CLINICAL RELEVANCE: Understanding how foot and/or ankle pathology affects foot muscle strength may lead to improved intervention planning in managing patients. The trend of greater strength of the healthy foot in this pilot study should be further investigated to determine if specific types of pathology are associated with foot weakness. Differences in force production between the seated and standing positions should be considered in exercise prescription for foot intrinsic strengthening.

OP0218
ATTITUDES AND PERSPECTIVES ON ANKLE FUNCTION IN PEOPLE WITH HEMOPHILIA: A QUALITATIVE STUDY

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PURPOSE/HYPOTHESIS: For people with hemophilia, mild trauma can cause internal joint bleeding. Over time, repeated bleeding episodes can result in joint stiffness and pain, limited range of motion, and ultimately irreversible bony changes. Ankles are a frequently affected joint and ankle pain occurs relatively early in life. Impaired ankle function can affect the ability of people with hemophilia to participate in activities of daily living, work and leisure. The purpose of this study was to explore the experiences and priorities of people with hemophilia A or B regarding their foot and ankle function, activity and participation.

NUMBER OF SUBJECTS: Eleven.

MATERIALS/METHODS: Eleven participants with hemophilia A or B, 21 years and older with a history of ankle pain, were recruited from a sample of convenience from the Pacific Northwestern, USA. Individual and group interviews were conducted using a semi-structured format. The interviews were recorded, transcribed and then analyzed using thematic analysis with NVivo 10 Software.

RESULTS: Four themes emerged: (1) “Pain impacts my daily life, but I still have to get things done.” Participants reported an expectation of joint pain but were more concerned with how pain affects their ability to participate in activities they want to do. (2) “Management of ankle function is highly individualized.” Participants reported a wide variety of personal strategies and techniques including but not limited to orthotics, footwear, adaptive equipment, medications and exercise. (3) “Self-advocacy is crucial.” Participants reported self-advocacy skills as necessary in order to receive quality care but often expressed frustration that achieving normalization of LM, lumbar and thoracic erector spinae (LES, TES), latissimus dorsi (LD), gluteus maximus (GMX) and hamstrings (HS) bilaterally. Muscle activations were normalized to maximal volitional contractions. Principal component analysis (PCA) was used to extract muscle synergies used by individuals with and without LBP during leg raising. Mixed ANOVA com-

CONCLUSIONS: For our participants, joint pain and ankle dysfunction affect daily life. Expressed themes highlighted priorities for participation, health management and for desired health care. The sample was limited to participants in the Pacific Northwest in the United States and therefore may only be generalized to this demographic.

CLINICAL RELEVANCE: As health care moves from volume-based to value-based care delivery, the patient’s voice is increasingly important in prioritizing the most impactful interventions. The participant-identified priorities and experiences from our study can begin to inform health care providers, allowing them to deliver more impactful care, improved rapport, and more valuable services for their patients with hemophilia.

OP0219
A NOVEL INDEX BASED ON KINEMATIC AND KINETIC MEASURES FOR SPINAL STABILITY IN SUBJECTS WITH RECURRENT LOW BACK PAIN

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PURPOSE/HYPOTHESIS: The purpose of this study was to evaluate the relationship between normalized kinematic and kinetic stability indices for spinal regions during nondominant leg standing with eyes-open and eyes-closed conditions between subjects with recurrent low back pain (LBP) and control subjects.

NUMBER OF SUBJECTS: Forty-two subjects participated in the study, including 22 subjects with LBP (12 male, 10 female) and 20 control subjects (12 male, 8 female).

MATERIALS/METHODS: The kinematic stability index for the spinal regions (core spine model, lumbar spine, lower thorax, and upper thorax) and the kinetic stability index (utilizing force plate) were measured. All participants were asked to maintain nondominant leg standing for 25 seconds, with the dominant hip and knee flexed approximately 90°.

RESULTS: For the kinematic index for stability, the visual condition (F = 30.06, P = .0001) and spinal region (F = 10.82, P = .002) were statistically significant. The post hoc test results indicated a significant difference in the lumbar spine compared with the upper and lower thorax and the core spine model. The kinetic stability index during the eyes-closed condition significantly decreased in the LBP group (t = −3.24, P = .002).

CONCLUSIONS: The subjects with recurrent LBP demonstrated higher lumbar spine stability in the eyes-open condition. This higher stability of the lumbar spine might be due to a possible pain avoiding strategy from the standing limb. The LBP group also demonstrated significantly decreased kinetic stability during the eyes-closed condition.

CLINICAL RELEVANCE: The subjects with recurrent LBP rely on visual input due to decreased proprioception from lumbar spine injuries while minimizing normalized kinetic changes from the ground. Clinicians need to consider both kinetic and kinematic indices while considering visual condition for lumbar spine stability in subjects with recurrent LBP. Funding source: Central Michigan University.

OP0220
LUMBAR SPINE STIFFNESS CHANGES AND MUSCLE ACTIVATION DURING THE PRONE INSTABILITY TEST

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PURPOSE/HYPOTHESIS: Prone instability testing (PIT) is used to identify individuals with low back pain (LBP) that would benefit from trunk stabilization exercises. Theoretically, activity from muscles such as the lumbar multifidus (LM) enhances spinal stiffness during leg raising of the PIT, resulting in pain reduction. However, this theory lacks evidence. Our purposes were: (1) compare and contrast lumbar spine stiffness changes and muscle activation patterns in individuals with and without LBP and (2) determine if preferential contraction of the LM during the PIT via electromyographic (EMG) recording and analysis shows effect of LM activity on lumbar spine stiffness.

MATERIALS/METHODS: Individuals (n = 10) with LBP (5 female; mean ± SD age, 29 ± 6 years) and individuals (n = 10) without LBP (NLBP) (2 female; mean ± SD age, 29 ± 3 years) performed the PIT. Three-dimensional kinematics measured lumbar spine stiffness (LSS) via a bending beam model. Stiffness changes were compared across PIT positions (prone, start position, leg raise) with repeated ANOVA, and between groups with a mixed ANOVA, α = .05. Surface EMG electrodes recorded muscle activity of LM, lumbar and thoracic erector spinae (LES, TES), latissimus dorsi (LD), gluteus maximus (GMX) and hamstrings (HS) bilaterally. Muscle activations were normalized to maximal volitional contractions. Principal component analysis (PCA) was used to extract muscle synergies used by individuals with and without LBP during leg raising. Mixed ANOVA com-

CONCLUSIONS: For our participants, joint pain and ankle dysfunction affect daily life. Expressed themes highlighted priorities for participation, health management and for desired health care. The sample was limited to participants in the Pacific Northwest in the United States and therefore may only be generalized to this demographic.

CLINICAL RELEVANCE: As health care moves from volume-based to value-based care delivery, the patient’s voice is increasingly important in prioritizing the most impactful interventions. The participant-identified priorities and experiences from our study can begin to inform health care providers, allowing them to deliver more impactful care, improved rapport, and more valuable services for their patients with hemophilia.
pared percent activation of individual muscles between groups.

RESULTS: All participants with LBP had a positive PIT with increases in LSS compared to prone position (P < .001). A significant increase in LSS was also found compared to prone (P < .042) in the NLBP group. LMES resulted in greater LSS compared to prone for both LBP (P < .029) and NLBP (P < .014) groups. PCA revealed 3 muscle synergies that explained 93% of the variance in individuals with NLBP, with 42% of the variance accounted for (VAF) by synergy containing the LM, LES, and LD. Individuals with LBP had only 2 synergies that yielded 77% of the variance, with 57% of the VAF by the synergy containing the TES, LD, and HS. NLBP had significantly greater activation of LM, LES, and GMX compared to those with LBP (P = .03).

CONCLUSIONS: LSS increased during the active leg raising portion of the PIT and was reproduced with LMES, supporting the role of LM muscle activity in increasing lumbar stiffness. Despite achieving a positive PIT, individuals with LBP had differences in their muscle activation patterns and reduced LM and LES activation that required different muscle synergies to achieve lumbar spine stiffening and a positive test.

CLINICAL RELEVANCE: Individuals with LBP demonstrate lumbar spine stiffening during the PIT, but may accomplish this using a different strategy compared to NLBP group. This may suggest altered neuromuscular control that responds to a stabilization exercises. The ability to obtain lumbar spine stiffening with LMES, may suggest its potential adjunctive role in rehabilitation.

OPO221

TRADITIONAL CRATE VERSUS XRTS LEVER ARM LIFT

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PURPOSE/HYPOTHESIS: Within a functional capacity evaluation (FCE), an individual’s sincere maximal effort must be determined. Objective tools or methods such as the traditional crate lift are used to assess sincerity of effort. The XRTS Lever Arm replicates the biomechanics of the crate lift. The purpose of this research study is to (1) compare the maximum lifting capacities on the XRTS Lever Arm with the traditional crate lift and (2) determine the relationship of perceived exertion between the XRTS Lever Arm and the traditional crate lift.

NUMBER OF SUBJECTS: A total of 41 subjects between ages 20 and 40 with no upper or lower extremity injuries within the past 12 months were recruited to participate in this study. Subjects who were able to lift more than 110 lb in the crate lift were excluded.

MATERIALS/METHODS: On the first day of testing, investigators established 1RM for each subject performing a lift from 20 inches off the ground to their navel using a traditional crate. Subjects were then randomly assigned 5 weights ranging from 10% to 100% of their determined 1RM and asked to give a rating of their perceived exertion (RPEs) after each lift. The subjects repeated the same procedure used for the crate lift 2 to 5 days later using the XRTS Lever Arm. For Purpose 1, paired t tests were used to compare maximal lifts between subjects. For Purpose 2, Spearman’s correlation coefficient was used to determine the relationship of perceived exertion between the XRTS Lever Arm and the traditional crate lift. For all statistical testing, alpha was set at less than .05.

RESULTS: There was a statistically significant difference (P < .04) between maximal lift values for the 2 lifting modes. The percent difference between the traditional crate lift and the XRTS Lever Arm was 10.5% ± 6.4% with values ranging between 0.82% and 23.78%. Of the 41 subjects, 38 of the subjects were below a 20% difference and 31 subjects were below a 15% difference. Additionally, there was a positive correlation between the RPE on the traditional crate lift and the XRTS Lever Arm (P = .92).

CONCLUSIONS: This validation study demonstrates that lift effort and perceived exertion are not different between lifting modes. Although the actual maximal lift values for the modes of lifting were statistically different the 2 modes of lifting are equivalent within the standard 20% percent difference.

CLINICAL RELEVANCE: It is challenging to determine an individual’s sincerity of effort based on visual observation alone during an FCE. Patients whose efforts are not sincere during physical evaluation may overuse treatment, have prolonged recovery, or increased cost of care. Ongoing research using distraction based lifting with the XRTS Lever Arm for determining patient effort during testing is needed in which data collection simulates the clinical environment by testing subjects for both modes of lifting on the same day rather than on 2 separate days. Further, increased scientific evidence to support objective measurement of effort will assist in eliminating clinician bias in determining functional capacity evaluation results.

OPO222

THE EFFECTS OF DIFFERENT VERBAL INSTRUCTIONS ON HOP HEIGHT AND CONTACT TIME DURING THE VERTICAL HOP TEST IN RECREATIONAL ATHLETES POST-ACL RECONSTRUCTION

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PURPOSE/HYPOTHESIS: The purpose of this study was to assess the effect of 2 verbal instructions on contact time and jump height during performance of a vertical hop test in recreational athletes post ACL reconstruction. We hypothesized that participants’ contact times would decrease when asked to perform the test as fast as possible and hop height would remain similar. We also hypothesized that no differences would exist between limbs for both contact time and hop height.

NUMBER OF SUBJECTS: Twelve college-aged recreational athletes (9 female, 3 male) who had undergone ACL reconstruction surgery were included in this study. Participants were currently active 2 times per week for a minimum of 30 minutes and participated in jumping/cutting activities at least 1 time per month.

MATERIALS/METHODS: Participants performed a vertical hop test which consisted of 5 consecutive hops on the same lower extremity. An optical measurement system (Optojump, Microgate, USA) was used to determine contact time and hop height. Participants were instructed to hop as high as possible on 1 leg. During the landing, participants were instructed to try to land in the same spot. The vertical hop test was then repeated in the same manner, but participants were instructed to perform the test as quickly as possible. Mixed model ANOVAs (instruction by limb) were performed to analyze for potential differences and Tukey’s post hoc test was used for multiple pairwise comparisons.

RESULTS: A significant interaction (P = .04) was demonstrated for contact time. Contact times were faster when participants were asked to perform the hops as quickly as possible (1.88 seconds versus 0.57 seconds, P = .005). Additionally, contact time on the involved limb was greater than the uninvolved limb (2.03 seconds versus 1.73 seconds, P = .005). This difference between limbs was not demonstrated when participants were asked to hop as quickly as possible (0.59 seconds versus 0.55 seconds, P = .91). A significant limb effect (P = .009) was demonstrated for hop height indicating that hop height on the involved limb was less than the uninvolved limb for both instructions (13.7 cm versus 14.7 cm and 12.4 cm versus 13.8 cm).

CONCLUSIONS: Results indicate that vertical hop test verbal instructions have an effect on contact time and hop height. Participants tended to increase contact time on their involved lower extremity in efforts to maximize hop height when instructions focused primarily on hop height. There were no differences in contact time between limbs when participants were asked to perform the test as quickly as possible. Hop height differences were similar between limbs for both instructions.

CLINICAL RELEVANCE: The vertical hop test has the potential to demonstrate asymmetries in hop height regardless of how fast a person performs the test. Instructions that are linked to how quickly a person performs the test...
may result in more symmetrical contact times, thus hiding potential limb differences that maybe related to power development.

**OP0223**

**3-YEAR OUTCOMES FOR PATIENTS WITH NECK AND BACK PAIN PARTICIPATING IN AN OPTIMIZED PHYSICAL THERAPY MANAGEMENT PROGRAM**

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**PURPOSE/HYPOTHESIS:** Previous research has demonstrated that early PT consultation for patients with low back pain improve outcomes and decrease cost utilization. Additionally, physical therapy continues to be an underutilized part of care for patients with back and neck pain. The purpose of this study is to describe the 3-year outcomes of patients participating in a novel Back and Neck program where Physical Therapy was optimally utilized.

**NUMBER OF SUBJECTS:** The study involves 604 patients with neck and/or back pain who received guideline oriented care by physical therapists over a 3-year period.

**MATERIALS/METHODS:** The data included patients who were seen via direct access or through referral. For all patients, patient report outcomes for pain, disability, depression, and quality of life were captured. Descriptive statistics examined average number of visits and change scores for measured outcomes.

**RESULTS:** Of the enrolled participants 440 were female (73%) and the sample had an average age of 48.84 years. Of those enrolled, 197 (33%) had cervical complaints, 370 (61%) had lumbar complaints, and 33 (6%) had both. Twenty-nine percent of patients in cohort reported radiating symptoms, 30% of the lumbar patients, and 32% of cervical patients. One hundred forty-eight (25%) of the patients were categorized as acute (symptoms less than 90 days). Patients were seen on average for 6.8 visits. Patients demonstrated a 3.7 (95% CI: 3.411, 3.942; P < .0001) point reduction on a numeric pain-rating scale, representing a 64% reduction from baseline. Patients demonstrated a 8.4 (95% CI: 7.216, 9.454; P < .0001) and 7.5 (95% CI: 5.776, 8.286; P < .0001) point reductions on the Modified Oswestry Disability Index and Neck Disability Index, respectively. No significant changes in quality of life and depression were noted (P > .05).

**CONCLUSIONS:** Our study demonstrates that patients entering a program where physical therapy is optimally utilized demonstrate significant reductions in pain and disability. Changes in pain and disability exceeded statistical significance, minimally clinically important difference, and 50% reduction threshold.

**CLINICAL RELEVANCE:** This finding further supports the idea that PT should be utilized early in the care seeking episode of patients with back and neck pain and potentially at greater rates than is contemporary practice.

**OP0224**

**DIFFERENTIAL KNEE JOINT LOADING PATTERNS DURING GAIT FOR INDIVIDUALS WITH TIBIOFEMORAL AND PATELLOFEMORAL ARTICULAR CARTILAGE DEFECTS IN THE KNEE**

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**PURPOSE/HYPOTHESIS:** Knee impairments are common in individuals with articular cartilage defects (ACD) in the patellofemoral (PF) or tibiofemoral (TF) compartment of the knee and may induce a protective response to unload the ACD. Yet, it is unknown if individuals with ACDs modify activity to provide compartment-specific unloading. The purpose of this study was to elucidate the compartment-specific loading patterns during gait, quantified as joint reaction forces (JRF), of individuals with knee ACDs compared to healthy controls. We hypothesized that individuals with ACDs would unload the affected compartment during gait.

**NUMBER OF SUBJECTS:** Twenty-seven individuals with ACDs, 19 healthy controls (HC).

**MATERIALS/METHODS:** Individuals with ACDs were divided into groups according to ACD location: PF (only PF ACD), TF (only TF ACD), and MIX (both PF and TF ACDs). The involved limb was randomly assigned in the HC group. Participants underwent 3-D gait analysis at self-selected speed. TF-JRF was calculated using inverse dynamics. PF-JRF was derived from an estimate of quadriceps force and knee flexion angle. The primary variables of interest were first and second peaks for the PF- and TF-JRF (units body weight [BW]), corresponding with each half of stance. Secondary variables included gait speed, quadriceps strength, knee function (Knee Injury and Osteoarthritis Outcomes Score) and activity level (Tegner Activity Scale). We tested for group differences in peak PF-JRF and TF-JRF with a multivariate analysis of variance. Related secondary variables (correlation analyses, P < .05) were added as covariates in a multivariate analysis of covariance.

**RESULTS:** The first peak PF-JRF and TF-JRF were similar in the TF and MIX groups (0.75-1.0 BW, P = .6-.9). Both peaks were also similar in the PF and HC groups (1.1-1.3 BW, P = .7-.8), and higher than the TF and MIX groups (P = .004- .02). For the second peak PF-JRF, only the HC group was higher than the TF group (P = .02). In the full sample, gait speed was related to all JRF peaks (r = 0.53-0.78, P < .01), while quadriceps strength was related to TF-JRF peaks (r = 0.33-0.34, P < .05). When gait speed and quadriceps strength were included as covariates, there were no differences for any JRF peak. In individuals with ACDs, JRF peaks were generally not related to knee function and activity level, and group differences persisted when accounting for these variables.

**CONCLUSIONS:** Individuals with TF ACDs (TF and MIX groups) walked slower, which was associated with lower joint loads. Walking slower may be a protective gait modification to reduce load for individuals with TF ACDs, but was not observed in those with PF ACDs. Walking is likely a more provocative activity for TF ACDs compared to PF ACDs, as the TF joint is weight bearing throughout stance. Future work should examine joint loading in tasks that engage the PF joint, such as stair climbing or squatting.

**CLINICAL RELEVANCE:** Physical therapists should consider ACD location in selecting exercises and recommending activity modifications in individuals with ACDs in the knee.

**OP0225**

**MENSENCHYMAL STEM CELL FATE IS INFLUENCED BY RECRUITMENT OF mTORC2 TO THE CELL MEMBRANE BY MYOSIN MOTOR DOMAINS**

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**PURPOSE/HYPOTHESIS:** Bone quality and quantity is inversely proportion-al to adipogenic commitment of marrow derived mesenchymal stem cells (MSCs), where increased adipogenesis depletes the progenitor pool for osteogenesis. Mechanical strain suppresses adipogenesis by activating a cascade involving Fyn, mTORC2, and Akt, culminating in both enhanced Beta catenin nuclear entry and cytoskeletal reinforcement. Previous work has demonstrated that this signaling cascade initiates at focal adhesion (FA) platforms, where strain recruits both Fyn and mTORC2 to amplify downstream responses; however, the mechanisms responsible for recruit-
ing these signals to FAs is unclear. A mechanical strain induces actin cytoskeletal stress fibers, while disruption of this structure prevents activation of the Fyn/mTORC2/Akt cascade. Furthermore, visualization of Akt, using immunostaining, after mechanical strain, reveals Akt localized to biaxial mechanical strain (2%, 100 cycles). Antibodies were used for immuno-precipitation, followed by mass spec analysis or Western blotting. For Western blotting, 20.25 g of total cell lysate was loaded per well. Following polyacrylamide gel electrophoresis, proteins were transferred to PVDF membranes, blocked with milk and probed overnight with primary antibodies. After a 2 hours incubation with secondary antibodies, blots were exposed using ECL reagent. After a 2 hours of incubation with secondary antibodies, blots were exposed using ECL reagent.

**RESULTS:** Myosin are molecular motors that carry “cargo” to intracellular locations. Myosins are motor molecules that regulate cytoskeletal reorganization in adipocytes, requiring a role in adipogenic commitment. Mass spec analysis revealed a strong association of Rictor with both myosin 1C and myosin 9. Co-immunoprecipitation studies confirmed that both myosin 1C and myosin 9 bind Rictor. Importantly, mechanical strain enhanced the binding of myosin 1C with Rictor, while the affinity of myosin 9 with Rictor was not affected.

**CONCLUSIONS:** These data suggest that myosin 1C is a critical component of strain-induced recruitment of signaling effector to the plasma membrane, where signal amplification restricts adipogenesis. As activation of signaling cascades that direct MSC lineage are temporally and spatially regulated, force is necessary for spatial partitioning of Fyn/mTORC2/Akt. Myosin motors are necessary for carrying this “signaling cargo” to FAs, where force is transmitted, and subsequent signal activation occurs.

**CLINICAL RELEVANCE:** This work seeks to identify the mechanisms by which MSCs sense mechanical force, and direct signaling molecules to focal contact points in the cell, where force is translated into biochemical signals that direct stem cell lineage fate to promote bone formation.

### OP0226

**VALUE OF WITHIN-SESSION AND BETWEEN-SESSION FINDINGS FOR LONG-TERM OUTCOMES FOR PATIENTS RECEIVING MANUAL THERAPY**

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**PURPOSE/HYPOTHESIS:** The purpose was to determine if early change leads to improved outcomes in patients who receive a manual therapy-oriented intervention. We hypothesized that early change carried over to a subsequent visit (between-session effects) will be more predictive of longer-term improved outcomes than immediate effects (changes within a session).

**NUMBER OF SUBJECTS:** Subjects involved individuals who received manual therapy treatment beyond 2 scheduled visits.

**MATERIALS/METHODS:** Relevant databases were searched up to November of 2015. Studies were included if they were a cohort study or RCT with covariate control and longitudinal design. Outcomes measured included pain, range of motion (ROM), global rating of change (GRoC) and select physical performance measures with variables assessed 96 hours after initial visit. Risk of bias influencing internal and external validity and fidelity (quality and strength of the intervention provided) were separately assessed.

**RESULTS:** Seven studies met the inclusion criteria and were included in the review. Early change in pain and GRoC were predictive of long-term improvements. Changes in disability were predictive of changes in pain, but not predictive of changes in function. Within-session changes in ROM were predictive of between-session changes.

**CONCLUSIONS:** The hypothesis of between-session findings are an important form of early change, and can predict treatment success was supported. This review disputes the idea that within-session changes are as strong of a clinical predictor for patient progress as patient’s between-session changes. Therefore, between-session changes are a more effective tool for determining patient plan of care.

**CLINICAL RELEVANCE:** There is a need for an adequate tool or predictor that can effectively identify patients who will be strong responders to manual therapy focused interventions. Between-session changes offer more value than immediate or within session changes in predicting improvements. This review supports that a more effective tool for prediction should include between-session changes in treatment rather than immediate changes or anything specific to the patient at baseline. Future research should focus on the prediction value of between-session changes over CPR and immediate effect studies.
CONCLUSIONS: Therapeutic rock climbing is feasible, safe and may constitute a valuable activity to be integrated into the physical therapy treatment regimen. Additional investigations of its beneficial effects in a larger cohort are desirable.

CLINICAL RELEVANCE: Due to improved medical treatment regimens patients with hemophilia are aging, but will present with arthropathies and other comorbidities. Providing this population group with treatment programs challenging their abilities, while contributing to their overall well-being in a safe environment is essential.

OP0228
THE EFFECT OF DRY NEEDLING ON SPINAL MUSCLE FUNCTION, PAIN, AND DISABILITY IN INDIVIDUALS WITH MECHANICAL LOW BACK PAIN: A DOUBLE-BLIND RANDOMIZED CONTROLLED TRIAL USING SHEAR-WAVE ELASTOGRAPHY
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PURPOSE/HYPOTHESIS: Lumbar muscle dysfunction is commonly implicated in low back pain (LBP) [1-4]. Dry needling (DN) is an intervention aimed at treating painful musculoskeletal conditions and muscular dysfunctions [5-8]. However, no randomized controlled trials have assessed the effects of DN on lumbar muscle function, pain, and disability in patients with LBP. The primary purpose of this study was to investigate the effects of DN on lumbar muscle stiffness at rest and during submaximal contractions in individuals with LBP and healthy people. Additionally we examined the short-term effects of DN on pain and related disability in those with LBP.

NUMBER OF SUBJECTS: Ninety-one individuals (60 with mechanical LBP and 31 without current LBP) volunteered to participate (44 male; mean ± SD age, 31 ± 7 years).

MATERIALS/METHODS: Subjects with LBP were randomly allocated to receive true DN (n = 30) or sham DN (n = 30). Asymptomatic participants received true DN. Study outcomes included muscle stiffness, pressure algometry of the lumbar multifidus (LM) and paraspinal (PS) muscles, and the Oswestry Disability Index (ODI). Ultrasound shear wave elastography (SWE) was used to measure LM and PS stiffness at rest and during a submaximal contralateral arm lift while holding a small weight [3]. Images of the LM and PS muscles were captured at the right L4 level in asymptomatic subjects and on the painful side at the most painful level of the L3, L4, or L5 vertebral levels in patients with LBP. A single session of dry needling of the LM and PS muscles was performed at the right L4 level in asymptomatic individuals. True or sham DN was applied to the painful side at the most painful level of the L3, L4, or L5 levels in patients with LBP. All measures were obtained before and immediately after the DN intervention. Study outcomes were obtained immediately after and 1 week after treatment, except the ODI which was measured only at the 1-week follow-up. Between-group comparisons were analyzed using ANCOVAs with baseline scores as covariates.

RESULTS: No significant differences were found in LM or PS stiffness between any groups at either time point. However, a consistent trend indicated larger decreases (3%-11%) in stiffness in the true DN group compared to sham DN across both muscles and at both time points in patients with LBP. There were no consistent between-groups differences in study outcomes of pain or related disability.

CONCLUSIONS: There were no clear differences in the efficacy of a single session of true DN versus sham DN on muscle stiffness, pain, and related disability in patients with LBP. However, a consistent trend indicated larger decreases in stiffness in the true DN group compared to sham DN.

CLINICAL RELEVANCE: A single session of DN does not appear to cause predictable changes in muscle function or clinical improvement in patients with LBP. However, as clinically relevant changes were found in some individuals with LBP, future studies should aim to identify populations that respond to DN.

OP0229
THE ASSOCIATION BETWEEN STATIC FOOT POSTURE AND HIP AND KNEE KINEMATICS DURING WALKING
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PURPOSE/HYPOTHESIS: Abnormal foot kinematics may affect more proximal mechanics of the lower extremity during weight-bearing tasks. While static foot postures have been related to foot and ankle mechanics, little is known regarding the relationships to the hip and knee. The Foot Posture Index (FPI) is a valid and reliable assessment of static foot posture. Therefore, this study aimed to correlate FPI scores with 3-D hip and knee kinematics during walking.

NUMBER OF SUBJECTS: Thirteen (8 female; mean ± SD age, 23.2 ± 1.09 years; weight, 70.0 ± 12.5 kg; height, 1.7 ± 0.09 m) healthy individuals provided bilateral data on 26 limbs.

MATERIALS/METHODS: Each limb was assessed using the FPI by a board-certified orthopaedic physical therapist. The FPI is a 6-item observation- and palpation-based assessment of static foot alignment, with higher positive values indicating a more pronated foot and lower negative values indicating a more supinated foot. Subjects were then fitted with an established retroreflective marker set bilaterally and performed 4 trials of level walking at a speed of 1.5 m/s. Kinematic data were collected at 100 Hz using an 8-camera motion capture system, and reduced in Visual3D using an x-y-z Euler rotation sequence. Pearson-product moment correlation coefficients were then calculated between FPI scores and 3-D hip and knee initial contact, excursion and peak angle data. An alpha level of .05 was applied for all significance testing.

RESULTS: There were moderate positive correlations between FPI score and knee frontal plane angle at initial contact (r = 0.408, P = .04) as well as knee frontal plane excursion (r = 0.467, P = .016), such that increased pronation was related to increased knee abstraction at initial contact and increased knee movement towards adduction during stance. There was also a moderate correlation between FPI score and maximum hip extension during stance (r = 0.545, P = .004), such that increased pronation was related to increased hip extension.

CONCLUSIONS: Increased pronation may contribute to increased dynamic valgus during weight bearing, accounting for some portion of the knee abduction movement during stance. Whereas, increased pronation may contribute to increased hip extension by allowing more time in late stance prior to push-off.

CLINICAL RELEVANCE: Static foot posture related moderately to hip sagittal plane and knee frontal plane kinematics during ambulation. Clinicians identifying abnormal motions at the hip and knee may consider evaluation of static foot posture. As this study is cross-sectional, prospective studies are needed to evaluate if these relationships are causative.

OP0230
THE RELATIONSHIPS OF TRUNK MUSCLE PERFORMANCE AND FOOT TYPE TO Y BALANCE PERFORMANCE
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PURPOSE/HYPOTHESIS: Lower extremity injuries can be both debilitating and costly. Efforts have been made to develop injury risk assessments, often focusing on functional mobility. As an established mobility test, the Y Balance test has been shown to be prospectively related to injury risk in athletic and military populations. However, it is likely that underlying factors such as strength and anthropometrics can influence Y Balance performance. Two such factors include trunk muscle performance and foot type. This study aimed to examine the relationship of trunk muscle performance and foot type to Y Balance performance.
A SURVEY STUDY
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PURPOSE/HYPOTHESIS: The primary purpose was to examine the association of professional experience level of PTs with referral decisions regarding magnetic resonance imaging (MRI), neurosurgical consult, and initiation of formal physical therapy for suspected acute lumbar disc herniation (LDH) with myotomal involvement. A secondary purpose of this study was to examine if there was an association between severity of myotomal deficit (presumed to be due to LDH) and likelihood of referral for each of the 3 respective categories. Lastly, identical clinical scenarios were compared both with and without presence of MRI findings to confirm clinical diagnosis of LDH to examine if there was an association between availability of MRI results and physical therapists’ referral for neurosurgical consult.

NUMBER OF SUBJECTS: Sixteen thousand six hundred twenty-six members of the orthopaedic section of the APTA were surveyed. The survey response rate was 13.2% (n = 2172).

MATERIALS/METHODS: The association between demographic characteristics and clinical questions was assessed using multivariable logistic regression (primary study purpose). Professional characteristics examined (in regards to clinical decisions) were years of clinical experience (15+ years versus 0-15 years), highest physical therapy degree held (ie, BSPT/MPT versus DPT), yes versus no regarding Fellow of the American Academy of Orthopaedic Manual Physical Therapists (FAAOMPT), and yes versus no regarding specialist certification from the American Board of Physical Therapy Specialties (ABPTS). McNemar test was utilized to examine secondary and tertiary purposes of the study (as listed in purpose/hypothesis section).

RESULTS: Years of clinical experience and type of PT degree influenced the likelihood of several referral decisions. ABPTS certification was not associated with referral decisions. FAAOMPT certification was associated with decreased likelihood of referral for MRI and neurosurgical consult. Greater myotomal deficit was correlated with greater likelihood of referral for MRI and neurosurgical consult and lower likelihood of initiating PT. The presence of imaging to confirm LDH was associated with increased likelihood of referral for neurosurgical consult.

CONCLUSIONS: This study suggests that demographic characteristics, greater myotomal deficit, and availability of MRI may influence clinical decisions regarding foot drop due to LDH.

CLINICAL RELEVANCE: Professional characteristics may influence the likelihood of referral decisions. Severity of myotomal deficits may influence likelihood of referral decisions for additional imaging or neurosurgical consult amongst physical therapists. More evidence quality describing an optimal timeline or preferred plan of care for patients with this diagnosis is needed. The association between MRI results and increased likelihood of neurosurgical consult supports current evidence that early imaging may be associated with greater future health care utilization.

OP0231
CURRENT DECISION MAKING OF PHYSICAL THERAPISTS IN THE MANAGEMENT OF PATIENTS WITH FOOT DROP SECONDARY TO NERVE ROOT COMPROMISE DUE TO ACUTE LUMBAR DISC HERNIATION: A SURVEY STUDY
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PURPOSE/HYPOTHESIS: The purpose of this study was to explore the intrarater reliability of obtaining Rehabilitation Ultrasound Images (RUSI) of the sacral multifidi muscles at rest and during a maximum voluntary contraction (MVC) in healthy individuals with no report of low back pain.

NUMBER OF SUBJECTS: Fifteen healthy, normal subjects between the ages of 18 and 65 years old.

MATERIALS/METHODS: After signing an informed consent and obtaining anthropometric data, each subject was placed in a prone position with a pillow beneath the abdomen. Palpation of the inferior-most aspect of the right PSIS was performed and used as the initial starting point for obtaining images of the multifidi at the level of S2. With the transducer placed horizontally, gel was applied and the image was obtained using the PSIS and median sacral crest as landmarks for identification of the multifidi at rest. The same process was utilized to obtain an image of the left multifidi. After obtaining images of both multifidi at rest, an image of right then left multifidi was obtained during the performance of an MVC against a manually-resisted isometric force into lumbar extension. Two images were obtained both at rest and during a contraction for each subject, alternating between subjects. All measures were obtained in the same session by a single examiner who had minimal training in RUSI. Muscle thickness was determined by measuring the perpendicular distance between the superficial fascia and the deepest aspect of the muscle. Both intrarimage, intrarater reliability (error associated with 1 examiner measuring sacral multifidi thickness on 1 ultrasound image) as well as interimage, intrarater reliability (error associated with the procedures used to obtain standardized image location and measurements from 2 separate ultrasound images) were determined.

RESULTS: Good to excellent intrarater reliability (ICC≥0.7) with low SEM
scores were established for intrimage and interimage RUSI measurements of bilateral sacral multifidi.

**CONCLUSIONS:** Intra and inter rater reliability were demonstrated for obtaining measurements of the sacral multifidus muscle at rest and during an MVC using RUSI. Good reliability for RUSI measurements of the transverse abdominis and lumbar multifidi has been determined by several authors. The result of the current study provide additional reliability data for the use of RUSI in the measurement of the sacral multifidus muscle at rest and during an MVC. These results support the use of RUSI for assessing the morphology of this muscle, which may be used to quantify the response of the sacral multifidus to injury and to evaluate the impact of therapeutic interventions on muscle function.

**OP0233**

**A PRAGMATIC REGIONAL INTERDEPENDENCE APPROACH TO FROZEN SHOULDER: A CASE SERIES**

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**PURPOSE/HYPOTHESIS:** Frozen shoulder is known for slow improvement with motion deficits that last for years. No physical therapy treatments listed in a recent clinical practice guideline—all directed at the glenohumeral joint—received a Grade A recommendation, including patient education or stretching (Grade B), and modalities or joint mobilization (Grade C). The purpose of this case series was to describe the pragmatic application of a regional interdependence approach for frozen shoulder and synthesize outcomes. Secondary purposes were to assess whether (1) final shoulder range of motion (ROM) approached normal values, (2) ROM changes followed a time-related pattern, and (3) functional outcomes were maintained at follow-up.

**NUMBER OF SUBJECTS:** Five.

**MATERIALS/METHODS:** This retrospective case series analyzed existing data from consecutive patients referred with frozen shoulder diagnoses within 1 year. After confirming the diagnosis with clinical findings, 1 physical therapist used a pragmatic regional interdependence approach that included treatment to the shoulder girdle (sternoclavicular and acromioclavicular joints, first rib), shoulder (glenohumeral joint, rotator cuff muscles), scapulo-thoracic/humero-thoracic (pectoralis major/minor, latissimus dorsi, serratus anterior muscles); and cervical-thoracic/costovertebral joints. A pragmatic treatment approach allows selecting interventions chosen based on clinical impairments identified by the clinician. Interventions included joint mobilizations (grades III-V, mobilization with movement, strain-counterstrain, muscle energy techniques), soft tissue mobilization, muscle stretching and strengthening, patient education, and modalities and aerobic warm-ups. Outcomes included shoulder ROM upon discharge and the Disability of Arm, Shoulder, and Hand (DASH) functional outcome measure at approximately 4 weeks follow-up.

**RESULTS:** Subjects came for 11 to 21 sessions (mean, 15) over 4 months. All subjects improved on all outcomes, thus group means were reported. ROM increased for flexion (117° ± 10° to 179° ± 12°, d = 5.9), abduction (74° ± 8° to 175° ± 9°, d = 9.3), and external rotation (23° ± 7° to 89° ± 2°, d = 12.0) with large effect sizes at discharge. DASH scores at mean 11 months post-discharge improved from 40.0 ± 19.4 at evaluation to 6.2 ± 3.7 at follow-up (d = 1.5), exceeding the minimal clinically important difference.

**CONCLUSIONS:** A pragmatic regional interdependence approach yielded large effect size ROM and shoulder function improvements for 5 patients with frozen shoulder. Final ROM approached normal values with most gains achieved early and large effect size functional outcomes were evident months after discharge. The conception that ROM deficiencies in frozen shoulder last years was not supported in these cases.

**CLINICAL RELEVANCE:** A pragmatic approach that directs treatment to related regions beyond the shoulder joint may provide benefits in cases of frozen shoulder. Controlled study of the effects of a pragmatic regional interdependence treatment approach on ROM and function in frozen shoulder patients is warranted.

**OP0234**

**THE EFFECT OF SPINAL MANIPULATION ON BREATHING PATTERN AT REST**

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**PURPOSE/HYPOTHESIS:** The effects of spinal manipulation (SM) are known to have neurophysiologic effects. Breathing pattern (BP), is thought to have a bidirectional relationship with autonomic nervous system (ANS). Moreover, abnormal BP and hypocapnia have been associated with low back pain. BP was defined in this study as respiration rate (RR), tidal volume (VT), and minute ventilation (VE). The purpose of this study was to assess the effect of SM on BP in healthy subjects.

**NUMBER OF SUBJECTS:** Eighteen.

**MATERIALS/METHODS:** Subjects underwent breath-by-breath respiratory gas analyses (RGA) for 15 minutes in supine before and after receiving SM targeting the thoracic spine. Maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) were also measured. Statistical analyses included Wilcoxon signed-rank tests to compare RGA before and after SM, and independent samples Mann-Whitney U tests to compare subjects with MIP and MEP values less than or greater than 120 cmH₂O. The purpose of this study was to describe the pragmatic application of a regional interdependence approach for frozen shoulder and synthesize outcomes. Secondary purposes were to assess whether (1) final shoulder range of motion (ROM) approached normal values, (2) ROM changes followed a time-related pattern, and (3) functional outcomes were maintained at follow-up.

**RESULTS:** Analysis of the entire sample revealed a statistically significant decrease in VE after SM (5% decrease, P = .01), but no significant difference in any other variables. However, BP after SM was significantly (P < .05) different in subjects with MIP and MEP values greater than 120 cmH₂O compared to those with values less than 120 cmH₂O. Subjects with MIP less than 120 cmH₂O demonstrated an 8% decrease in VE, whereas those with MIP greater than 120 cmH₂O demonstrated a 2% increase in VE after SM (P = .006). Significant (P < .05) differences in RGA of subjects with MEP less than 120 cmH₂O compared to subjects with MEP greater than 120 cmH₂O after SM were found for RR (2% increase versus a 6% decrease, respectively; P = .04); VT (12% decrease versus 5% increase, respectively; P = .005), and VE (8% decrease versus 1% decrease, respectively; P = .04). Dichotomized MIP and MEP groups did not differ in regards to sex, expectations, or baseline BP measures.

**CONCLUSIONS:** SM appears to decrease VE, but MIP and MEP performance appear to have a potential modifying effect on BP after SM. The results of this study suggest that subjects with more robust ventilatory systems (ie, MIP and MEP values greater than 120 cmH₂O) tend to respond to SM by slowing RR and increasing VT, which is often a desired BP response and commonly associated with diaphragmatic breathing or breathing exercises for stress reduction. However, subjects with maximal pressure less than 120 cmH₂O had an opposite response, with slight elevations in RR and decreased VT. The cutoff point of 120 cmH₂O is approximately the age predicted normal value for this cohort (confidence interval: 116, 140), and may be a useful biomarker for predicting BP response to SM.

**CLINICAL RELEVANCE:** Better understanding of the underlying mechanisms, as well as mediating and modifying factors, may allow practitioners to better predict BP response to SM. Due to the known neurophysiologic effects of SM, bidirectional relationship with breathing and the ANS, and known association of altered BP and spinal pain conditions, understanding BP response to SM may provide additional insight into the often disparate responses to SM between patients, and help improve patient selection and outcomes with SM.
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**OPO235**

RESTING HEART RATE AND HEART RATE RECOVERY DIFFER BASED ON PAIN MECHANISM CLASSIFICATION

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**PURPOSE/HYPOTHESIS:** There is conflicting evidence in regards to the association of cardiovascular risk factors and low back pain (LBP). Previous studies on this relationship have either looked at LBP as a homogenous group, or distinguished between localized versus radiating symptoms. It has been advocated that viewing LBP patients as a heterogeneous group, and categorizing them based on neurophysiologically pain mechanisms (nociceptive (NO), neuropathic (PN), and central sensitization (CS)) may improve both clinical and research outcomes. The purpose of this study was to assess if patients with constant LBP, of at least 1 month duration, differed in resting vital signs and heart rate recovery (HRR) based on their pain mechanism classification. It was hypothesized that subjects categorized as NO would have lower resting heart rate (RHR), lower blood pressure (BP), higher peak heart rate (PHR), and a higher heart rate recovery (HRR) than those in the PN and CS pain mechanism groups. Furthermore, subjects with PN pain would have lower HR, BP, and higher PHR and HRR than subjects with CS.

**NUMBER OF SUBJECTS:** Fifteen subjects with constant LBP were consecutively recruited from an outpatient physical therapy clinic.

**MATERIALS/METHODS:** Subjects first received a brief interview and physical examination to determine pain mechanism category. The Pain Catastrophizing Scale (PCS), Oswestry Disability Index (ODI), and numeric pain-rating scale (NPRS) were then administered. Resting BP and HR data were collected. One minute HRR was assessed after 15 minutes of walking at a self-determined pace on a treadmill. Subjects were instructed to walk at a brisk pace that they could maintain for the entire 15 minutes.

**RESULTS:** Independent-samples Kruskal-Wallis tests (P<.05) were used to assess distribution across groups. Groups did not differ for age, sex, BMI, number of comorbidities, or chronicity. Groups also did not differ for resting systolic or diastolic BP, PCS, ODI, or NPRS for current, best, or worst pain level. However, significant differences between groups were noted for RHR (averages of 79 for NO, 78 for PN, and 65 bpm for CS), PHR (averages of 105 for NO, 95 for PN, and 88 bpm for CS), and HRR (averages of 20 for NO, 12 for PN, and 11 for CS). No statistical difference was found for heart rate reserve (PHR-HRR) between groups.

**CONCLUSIONS:** As expected, PHR and HRR were highest in the NO group and lowest in the CS group. Contrary to expectations, resting HR was highest in the NO group and lowest in the CS group, and groups did not differ in regards to BP.

**CLINICAL RELEVANCE:** Attenuated HRR after exercise is thought to be a marker of reduced parasympathetic activity and is an independent predictor of all-cause mortality. PHR and HRR after a simple self-selected walking test may also provide important information for pain mechanism classification and prognostication in patients with constant LBP.

**OPO236**

INCLUSION OF PHYSICAL THERAPY IN AN INTERPROFESSIONAL HEALTH PROGRAM SERVING THE HOMELESS POPULATION IN LOS ANGELES: A NEEDS AND FEASIBILITY STUDY

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**PURPOSE/HYPOTHESIS:** Competition with basic needs such as food and shelter is a barrier to the homeless accessing health care, and perceptions of discrimination due to being homeless have been shown to cause negative experiences that decrease the likelihood of the homeless seeking services. The Mobile Clinic Project (MCP) is an interprofessional collaboration among medical students, public health graduate students, and undergraduate students which has been providing weekly street-side medical and social support services to the homeless in West Hollywood, CA for 16 years. In 2014, approximately one third of cases were musculoskeletal (MSK) complaints. Therefore, we hypothesized that physical therapy (PT) would contribute to the medical care and health promotion goals of the MCP. The purpose of this study was to determine the need for and feasibility of providing street-side PT services to the homeless community.

**NUMBER OF SUBJECTS:** One hundred eighty-seven clients were served at the MCP during the study period.

**MATERIALS/METHODS:** First- and second-year student physical therapists (SPTs) (n = 13) from a Doctor of Physical Therapy program participated in 10 MCP clinics from November 2015 to June 2016. One to 2 clinical faculty members supervised and mentored the SPTs, who worked alongside the medical students and undergraduates to provide care and determine need for additional services or referrals. If PT services were recommended, the SPT performed a PT evaluation and treatment under the direct supervision of the attending PT and documented care in the clients’ clinic chart.

**RESULTS:** The client demographics were as follows: average ± SD age, 49.8 ± 12.0 years; 68.9% male, 31.2% female; 52.5% Caucasian, 21.3% Hispanic, 21.3% African American, 3.3% Asian/Pacific Islander; 31.6% of clients reported an MSK condition as their chief complaint; 78.7% of the PT-appropriate cases were MSK (73.3% upper quarter, 30.7% spine, 30.7% lower quarter). The nonMSK, PT-appropriate cases were neurologic, such as multiple sclerosis, spinal cord injury, peripheral neuropathy, and lumbar myelopathy. Follow-ups accounted for 23.7% of PT visits.

**CONCLUSIONS:** The high prevalence of homeless clients seeking medical care at the MCP for MSK conditions suggests a strong need for inclusion of PT in medical clinics that serve this population. As 23.7% of the PT visits were follow-ups, the potential exists for developing a consistent PT practice at the MCP. While further research is needed on the short and long-term impact of PT on MCP clients’ health and functional outcomes, existing studies suggest enhancing homeless patients’ functional mobility and decreasing activity limitations may lead to improved community participation and reduce high risk behaviors.

**CLINICAL RELEVANCE:** The Los Angeles Homeless Services Authority (LAHSA) reported the total homeless population in Los Angeles County in 2015 was 44,359 and homeless with physical disability was 8148. This study shows the need for and feasibility of providing street-side PT to improve function and mobility in this vulnerable population.
**Patients with a Fall History Have Worse Function and Strength Before and After Knee Arthroplasty**

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**Purpose/Hypothesis:** Falls are a primary concern among older adults with orthopaedic impairments. Approximately 45% of individuals after total knee arthroplasty (TKA) experienced a fall prior to surgery. At the prevalence of falls is high, it is not known whether falling prior to TKA predisposes individuals to a worse outcome after surgery. We hypothesized that individuals who experienced a fall prior to their TKA will have persistently lower physical function compared to those who did not fall prior to TKA.

**Number of Subjects:** One hundred twenty-three participants who underwent TKA (mean ± SD age, 66.3 ± 8.3 years; BMI, 33.2 ± 15.5 kg/m²).

**Materials/Methods:** Functional outcomes were assessed 2 to 4 weeks prior to TKA and 6 months after TKA. These included the Knee Outcome Score (KOS), knee range of motion (ROM), Timed Up and Go (TUG), Stair Climbing Test (SCT), 30-second Chair Rise Test (30SCRT), and 6 Minute Walk Test (6MWT). Maximum isometric quadriceps strength was also measured. All participants were categorized as a faller or nonfaller based on the response to “Have you experienced a fall in the previous 6 months?” which was asked at preoperative testing. Repeated-measures ANOVAs were used to determine differences between groups and between time points. In the presence of an interaction effect, follow-up t-tests were performed.

**Results:** Twenty participants experienced a fall prior to their TKA. There were no significant interaction effects for age, BMI, 30SCRT, 6MWT, and strength (all approximately P ≤ 0.5). There were no main effects for age, BMI, pain and ROM. There were main effects for time for the KOS (t = 33.3, P ≤ 0.01), 30SCRT (t = 20.8, P ≤ 0.01), and strength (t = 14.7%, P ≤ 0.02), which indicated all participants significantly improved after TKA regardless of group assignment. There were main effects of group for KOS (difference = 10.0, P = 0.02), 30SCRT (difference = 17.7, P = 0.03), 6MWT (difference = 62.0 m, P = 0.02), and strength (difference = 23.3%, P ≤ 0.01), which indicated that the fallers had lower functional outcomes and weaker quadriceps compared to the nonfallers regardless of the testing session. There was a significant interaction effect for TUG (P ≤ 0.04). Post hoc analysis revealed that the nonfallers improved 0.9 s after TKA (P ≤ 0.01), while the fallers improved 2.1 seconds (P < 0.01), but the fallers remained 1.9 s slower than the nonfallers 6 months after TKA.

**Conclusions:** Despite the consistent reduction in pain and improvements in self-reported function, physical function and strength remains lower in fallers before and after TKA. Although we did see that the fallers had a significantly better improvement in the TUG, it is likely that this improvement is related to the low ceiling effect for this measure. The fallers simply had more room to improve, given their poor preoperative TUG scores.

**Clinical Relevance:** Despite significant functional improvements after TKA, individuals who experienced a fall prior to TKA have persistently lower physical function. These individuals may require additional training to restore normal levels of physical performance and strength.
OP0240
CRITERION VALIDITY OF SHEAR-WAVE ELASTOGRAPHY COMPARED TO ELECTROMYOGRAPHY TO ASSESS LUMBAR MULTIFIDUS ACTIVATION
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PURPOSE/HYPOTHESIS: Low back pain is the most common cause of musculoskeletal health care visits among military personnel. Dysfunction in lumbar multifidus activation has been associated as a factor contributing to low back pain. The gold standard for muscle activation assessment has been electromyography (EMG); however, the invasive nature of EMG can be challenging for patients and providers [2]. Ultrasonic ShearWave Elastography (SWE) has emerged as a noninvasive technique to quantify tissue stiffness, and has been shown to be related to superficial muscle activity [3-5]. The purpose of this study was to evaluate the validity of SWE muscle activation in comparison to EMG during various lumbar multifidus contraction intensities.
NUMBER OF SUBJECTS: Fourteen asymptomatic individuals were enrolled.
MATERIALS/METHODS: The right L4 lumbar multifidus was located with B-mode ultrasound with the transducer oriented in parallel with the muscle fibers [1]. Muscle stiffness (shear modulus in kilopascals) was assessed via the Aixplorer ShearWave (SuperSonic Imagine, Aix-en-Provence, France) during rest, low, moderate, high and maximal isometric contractions [2]. Concurrently, lumbar multifidus activation was measured with fine wire electromyography using the Noraxon MR 3.8.6 software (Noraxon, USA Inc. Scottsdale, AZ). The EMG wire and insertion site were separated from the SWE transducer with 3M Tegaderm dressing. Three trials were captured for each condition. EMG contraction was converted to percent maximal voluntary isometric contraction.
RESULTS: Five subjects were excluded, 1 due to EMG instrumentation error, and 4 due to the inability of SWE to adequately capture lumbar multifidus stiffness. The remaining 9 subjects (6 female) had an average ± SD age of 26 ± 5.7 years and BMI of 22.7 ± 1.38 kg/m². A 1-by-5 repeated-measures ANOVA revealed a statistically significant main effect for muscle contraction for both EMG and SWE. Bonferroni post hoc analysis for SWE yielded a statistically significant difference between rest and all contraction levels (P<.004), and between max and all levels (P<.001). Visual analysis of SWE data suggested a curvilinear relationship across contraction levels. Muscle stiffness as measured by SWE showed fair correlation with EMG at the L4 multifidus level (r = 0.350, P = .020). When analyzing rest, low and moderate contractions only, the correlation was moderate (r = 0.583, P = .001).
CONCLUSIONS: Use of SWE to assess lumbar multifidus activation appears to be a potentially valid, noninvasive measure of muscle activation at lower levels of muscle contraction. Further work assessing SWE response across the entire range of muscle contraction is warranted.
CLINICAL RELEVANCE: SWE is a potential alternative for noninvasive, realtime assessment of deep spinal musculature. With clarifying work, SWE may eventually substitute when EMG or magnetic resonance imaging is considered to assess muscle response to exercise or treatment.

OP0241
SYMPATHOINHIBITION CAN IMPROVE FUNCTIONAL AND CLINICAL OUTCOMES IN ACUTE NECK PAIN: PRELIMINARY FINDINGS OF A RANDOMIZED CLINICAL TRIAL
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PURPOSE/HYPOTHESIS: Clinical measures relate to tendon mechanical properties following Achilles tendon rupture.
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CLINICAL MEASURES RELATE TO TENDON MECHANICAL PROPERTIES FOLLOWING ACHILLES TENDON RUPTURE
OP0242
CLINICAL MEASURES RELATE TO TENDON MECHANICAL PROPERTIES FOLLOWING ACHILLES TENDON RUPTURE
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CONCLUSIONS: Both low-dose LAT and AP improved neck disability with analogous sympathoinhibitory CR within 1 week. Furthermore, LAT improved CS rotation ROM more than AP.
CLINICAL RELEVANCE: Therefore, a subset of patients with NP and high BP may potentially benefit from low dose LAT (or AP) to improve function without further increasing BP but this requires further research.
Purpose/Hypothesis: Tendon mechanical properties have been previously reported to predict [4] and relate to [7] function in individuals post Achilles tendon rupture. While these properties can be useful in developing a prognosis and guiding treatment, expensive and invasive techniques limit translation into the clinic. Identifying clinical measures that could serve as surrogate measures of tendon mechanical properties would provide valuable information to the physical therapist treating these individuals.

Number of Subjects: Fourteen individuals within 1 year post–Achilles tendon rupture.

Materials/Methods: Fourteen individuals (mean ± SD age, 43.5 ± 15.2 years) after acute, unilateral Achilles tendon rupture were included in the study. The median (IQR) time since rupture was 3 (2–6) months with 10 subjects treated via surgical repair and 4 subjects treated nonsurgically. Achilles tendon length to the gastrocnemius myotendinous junction was measured using B mode ultrasound imaging [5]. Tendon mechanical properties including shear modulus and viscosity were quantified using continuous shear wave elastography (cSWE) [2,6]. Clinical outcomes included the Achilles tendon resting angle (ATRA) [1] and performance on the heel-rise test [7]. Participant self-reported activity level, function, and symptoms were measured using the Physical Activity Scale (PAS) and Achilles tendon total rupture score (ATRS), respectively.

Results: Participants demonstrated elongation of the tendon on the ruptured side, with a median (IQR) length of 22.2 (21.3–23.1) cm on ruptured and 21.2 (19.7–22.7) cm on nonruptured sides (P<.01). Viscosity was significantly less on the ruptured side, with a median (IQR) of 33.6 (29.3–42.5) Pa·s on rupture and 52.5 (46.4–62.4) Pa·s on nonruptured sides (P<.001). Shear modulus was not significantly different between sides, with a median (IQR) of 95.9 (72.3–106.7) kPa on rupture and 94.9 (91.0–101.1) kPa on nonrupture sides (P=.84). Participants performed less total work (P<.01), with less heel-rise height (P<.01) on the heel-rise test on the ruptured side (n = 10). ATRA related both to shear modulus (r² = 0.699, P<.01) and viscosity (r² = 0.637, P<.05) on the ruptured side. Total work on the heel-rise test related to shear modulus (r² = 0.642, P<.05) on the ruptured side (n = 10). Maximum heel-rise height was not related to shear modulus or viscosity (n = 10). Viscosity related to PAS score (r² = 0.559, P<.05). Shear modulus related to both PAS (r² = 0.581, P<.05) and ATRS scores (r² = 0.609, P<.05).

Conclusions: The results of this study indicate that mechanical properties are related to patient-reported activity level and self-reported function. Clinically, our results also support the use of ATRA and heel-rise test performance as surrogate measures for tendon mechanical properties in individuals less than 1 year post–Achilles tendon rupture.

Clinical Relevance: Clinical tests, such as questionnaires, ATRA and the heel-rise test, can be used to indicate recovery of mechanical properties in a physical therapy setting.