Immediate Effect of Using an Anterior to Posterior Cervical Mobilization Technique in a Patient Who Met the Clinical Prediction Rule for Cervical Radiculopathy

Emmanuel Yung
Sacred Heart University, yunge@sacredheart.edu

Follow this and additional works at: http://digitalcommons.sacredheart.edu/pthms_fac
Part of the Physical Therapy Commons

Recommended Citation
FACTORS PREDICTING IMPROVED OUTCOMES FOR INDIVIDUALS WITH CARPAL TUNNEL SYNDROME RECEIVING UPPER EXTREMITY MANUAL THERAPY

Bialosky JE, George SZ
Physical Therapy, University of Florida, Gainesville, FL

PURPOSE/HYPOTHESIS: Manual therapy (MT) may be effective in the treatment of carpal tunnel syndrome (CTS). Evidence suggests a greater effect of MT when individuals likely to respond favorably are identified. Features of individuals with CTS likely to respond to upper extremity (UE) MT have not been identified. The purpose of this study was to identify factors predictive of a positive change in clinical outcomes in individuals with CTS receiving UE MT.

NUMBER OF SUBJECTS: 40 participants between the ages of 18 and 70 with signs and symptoms of CTS.

MATERIALS/METHODS: Demographic information and questionnaires related to fear, catastrophizing, patient-centered outcomes of pain, and UE signs and symptoms of CTS.

RESULTS: Thirty-nine of the 40 (98%) participants (mean age, 46.9 years; SD, 10.3) median duration of CTS complaints 156 weeks) completed the study. Twelve out of 39 (31%) participants experienced a clinically meaningful change in UE disability. Expectation, importance of pain relief, and sensation to light touch in the median nerve distribution met statistical criterion and were entered into the model for UE disability. None of these variables were retained.

CONCLUSIONS: Positive ULTT and diminished sensation to light touch in the median nerve distribution predicted 3-week improvement in pain intensity following treatment with UE MT. No factors predicted 3-week improvements in UE disability.

CLINICAL RELEVANCE: Practitioners considering UE MT in the treatment of individuals with CTS should consider ULTT and median nerve sensation testing to direct treatment for pain.

BIOMECHANICAL ANALYSIS OF ELBOW END-FEEL TESTS IN DIFFERENT FOREARM POSITIONS

Wang Y, Hsu A, Wu C, Ciou M
Institute of Physical Therapy, National Cheng Kung University, Tainan, TAIWAN

PURPOSE/HYPOTHESIS: The purpose of this study was to use the elbow joint end-feel tests as a model to characterize the biomechanical properties of normal, i.e., the “approximation” and the “bone-to-bone” end feels in different forearm positions in young healthy adults.

NUMBER OF SUBJECTS: 23 subjects participated.

MATERIALS/METHODS: 10 male 13 female apparently healthy young subjects participated. The flexion (approximation) and extension (bone-to-bone) end feels were tested with the subject on a custom made treatment table with the forearm in supinated, neutral and pronated positions. An electromagnetic motion analysis system was used to track the kinematics and a uniaxial load cell for monitoring the force (thus the moment) of the elbow joint. Moment-angle curve for each trial were obtained.

RESULTS: The angular range of the toe region was larger in flexion (approximation) end-feel test than that of extension (bone-to-bone) test (P = .002). There is a difference in the angular stiffness in the latter portion of the toe region among different forearm positions. The angular stiffness of the latter portion of the toe region in neutral position is larger than those obtained in pronation (P = .016) and supination (P = .029). The angular stiffness of the neutral zone is greater in male subjects when compared with that of female subjects (P = .019). The range of the toe region of the flexion end feel test was correlated to the sum of the circumferences measured at 3 cm below and above the elbow (r = 0.504, P = .014).

CONCLUSIONS: The soft tissue approximation end feel of the elbow is char-
Act rivized by a greater angular range in the toe region when comparing with that of the bone-to-bone end feel. The angular stiffness of the latter portion of the toe region is influenced by forefoot position.

**CLINICAL RELEVANCE:** In testing the elbow end feel, the soft and hard end feels appear to be related to their corresponding angular range of the toe regions within the moment angle curve and the amount of soft tissue in between.

---

**OP02076**

**GAIT AND FUNCTIONAL TRAINING TO REDUCE GREAT TOE PAIN**

**Gelber JR, Sahrmann S, Hastings M**

Washington University in St Louis, St Louis, MO

**BACKGROUND AND PURPOSE:** Hallux Valgus is a foot deformity that often causes pain. Treatment strategies typically consist of toe or foot orthoses, footwear modification, and surgical correction. Pain often persists following surgery despite improved hallux valgus angles. The purpose of this case is to describe a movement system examination and intervention focused on lower extremity strength and motor control in a patient with painful hallux valgus.

**CASE DESCRIPTION:** The patient was a 23-year-old female with a 5-year history of great toe pain. She had a history of hallux valgus with a first metatarsal osteotomy 4 years prior and sesamoid excision and revision of osteotomy 2 years prior to beginning Physical Therapy. She reported that her pain was 8/10 and was unchanged by surgical intervention. Pain resolved during a period of casting, but returned after cast removal and return to shoes. She initially scored 75% on Foot and Ankle Ability Measure (FAAM), 100% representing full function. On initial examination, pain was reproduced with palpation at the first metatarsophalangeal joint (MTP). The patient presented with 5/5 ankle and toe strength and 3/5 gluteus medius strength bilaterally. Prone hip medial rotation was 45° and lateral rotation 25° with Craig test positive for anteversion. In standing she demonstrated genu valgum. The patient ambulated with increased femoral adduction, medial rotation and knee hyperextension. At the ankle she demonstrated pronation throughout stance with increased weight bearing on the great toe during stance and push-off. This pattern was reproduced on stairs, during sit to stand transitions and in static stance. The patient was diagnosed with ankle pronation. Impairments that contributed to her symptoms included weak gluteus medius, impaired lower extremity motor control, femoral anteverision and genu valgum. She was treated for 8 visits over 10 weeks. Initial treatment was aimed at offloading the first MTP, and strengthening hip abduction and lateral rotation. Subsequent sessions focused on performing functional activities, including ambulation, stairs and transitions, with an emphasis on decreasing femoral medial rotation, femoral adduction and knee hyperextension.

**OUTCOMES:** In the 10-week period, pain decreased from 8/10 to 0/10. Posterior gluteus medius strength improved from 3/5 to 4/5 bilaterally. FAAM scores improved from 76% to 89% in the first 4 weeks. The patient could walk without pain and had begun walking short distances for exercise. She demonstrated decreased femoral medial rotation and adduction during static standing, ambulation, transitions and steps. She demonstrated decreased knee hyperextension in static standing and ambulation.

**DISCUSSION:** This case demonstrates the resolution of chronic great toe pain with an individualized intervention based on movement impairments of the lower extremity. Gluteal strengthening and motor control of the hip and knee were key components of intervention. Contributions of the entire lower extremity should be considered in examination and treatment of foot and toe pain.

---

**OP02077**

**RELIABILITY OF FOOT ALIGNMENT RADIOGRAPHIC MEASURES IN DIABETIC NEUROPATHIC DEFORMITIES**

**Hastings M, Sinacore DR, Bohnert KL, Mercer-Bolton N, Prior FW, Vendt BA, Johnson JE**

Program in Physical Therapy, Washington University School of Medicine, St Louis, MO; Mallinckrodt Institute of Radiology, Washington University School of Medicine, St Louis, MO; Department of Orthopaedic Surgery, Washington University School of Medicine, St Louis, MO

**PURPOSE/HYPOTHESIS:** Foot deformity in individuals with diabetes mellitus (DM) and peripheral neuropathy (PN), contributes to ulceration, joint instability, and amputation. The purpose of this study is to report the interrater and intrarater reliability of radiological measures of foot deformity in subjects with DM, PN, and foot related complications.

**NUMBER OF SUBJECTS:** Fifteen subjects with DM, PN, and foot-related complications were studied (6 men, 9 women; age, 51 ± 9 years; BMI, 34 ± 5 kg/m²; duration of DM, 17 ± 9 years).

**MATERIALS/METHODS:** Radiographs of the foot were completed on all subjects. Sagittal alignment was quantified from lateral radiographs: (1) cuboid height-distance (mm) from plantar cuboid to the horizontal line from the plantar calcaneal tuberosity to the fifth metatarsal head, (2) calcaneal pitch, the angle between the line from the plantar aspect of the calcaneal tuberosity to the fifth metatarsal head and the line from the calcaneal tuberosity to the plantar, most distal aspect of the calcaneus, and, (3) Meary’s angle, the angle between a line from center of the dome of the talus, bisecting the talar neck and a line through the shaft of the first metatarsal. Transverse plane alignment was quantified from the anterior/posterior radiograph by measuring the angle between the talocalcaneal bisector and the shaft of the second metatarsal. A foot and ankle fellowship trained orthopedic surgeon measured all radiographs twice. A radiologist, in residency training, completed a 1 hour online tutorial and a 2 hour tutorial with the orthopedic surgeon, and then measured all radiographs once. Intra-rater correlations (ICC) were used to assess intrarater and interrater reliability. Least significant change (LSC) was calculated to determine the change in each measurement that needs to occur to be 95% confident that a real biological change has occurred.

**RESULTS:** Intrarater reliability ICC = 0.985 for cuboid height, ICC = 0.963 for calcaneal pitch, ICC = 0.971 for Meary’s angle and ICC = 0.940 for transverse plane measure. Interrater reliability ICC = 0.949 for cuboid height, ICC = 0.935 for calcaneal pitch, ICC = 0.937 for Meary’s line, and ICC = 0.914 for transverse plane measure. The LSC is 0.9 mm for cuboid height, 1.6° for calcaneal pitch, 2.8° for Meary’s angle, and 2.1° for the transverse plane measure.

**CONCLUSIONS:** Four radiological measures of sagittal and transverse alignment can be completed with excellent reliability within and between raters with minimal training. The LSC values indicate that small changes in angular and distance measures on radiographs are important and require close attention.

**CLINICAL RELEVANCE:** The ability to reliably measure foot alignment in a sample with DM, PN, and foot deformity will provide a needed tool to monitor and prevent disease progression and evaluate the effectiveness of intervention. Funded by NIH R01 DK059224, R21 HD048972, R21 DK079457
in normal limits, but hip and trunk strength were deficient. Abdominal strength measured 3+/5, hip extensors 4/5 and significant weakness in the frontal plane hip abductor muscles was noted as a 4–5 as measured by manual muscle testing. The patient scored a 6/9 on the Brighton Index for gross hypermobility and ankle range of motion exceeded normal limits with plantar flexion measured at 60°, 20° dorsiflexion, and 40° inversion. A wear pattern on the lateral aspect of both shoes, as well as pain along the lateral aspect of both feet suggested an abnormal gait pattern could be associated with the proximal weakness and repeated inversion ankle sprains. A literature search was conducted to answer the clinical “PICO” question: In patients presenting with chronic ankle instability, is distal joint instability associated with weakness of the proximal ipsilateral hip? Results of the search implicated a relationship between hip abductor weakness and chronic ankle instability.

OUTCOMES: Focus of treatment for this patient included closed kinetic chain exercises to emphasize hip strength while challenging ankle stability. Neuromuscular reeducation of the ankle using a BAPS board in a single leg stance position and later progressing to a Dynadisc was used to increase proprioception in the ankle while challenging hip abductors to maintain proper posture and alignment. Clinical outcomes seen included decreased frequency of ankle sprains; decreased ankle pain from 7/10 upon initial evaluation to 2/10 after 5 weeks of physical therapy treatment; increased hip abductor strength from 4–5 to a 5/5. Additionally, the Foot and Ankle Ability Measure administered to the patient over the course of treatment increased by twelve points, surpassing the nine point minimally clinical important difference needed to indicate a significant increase in the patient’s perceived level of functioning.

DISCUSSION: This report illustrates the manner in which a “PICO” question was developed and used to guide the physical therapy intervention of a patient with chronic bilateral ankle instability. The literature suggests a relationship between ankle instability and ipsilateral hip strength. A treatment plan including proximal strengthening led to positive clinical and functional outcomes for this patient.

**OPO2079**

**EFFECT OF THE MORTON’S EXTENSION CARBON FOOTPLATE ON PAIN, FUNCTION AND PLANTAR LOADING PATTERNS IN PATIENTS WITH HALLUX RIGIDUS**

Nawoczenski DA, Campbell E, Gorecki K, Kane G, Morris K, Tome J, Baumhauer JF

Physical Therapy, Ithaca College - Rochester Center, Rochester, NY; Orthopaedics, University of Rochester Medical Center, Rochester, NY

PURPOSE/HYPOTHESIS: Hallux rigidus or degenerative arthritis of the first metatarsophalangeal (first MTP) joint affects 1 in 45 people over the age of 50. Dorsal osteophytes, pain, loss of first MTP joint motion, and gait alterations are hallmark features of this disorder. While foot orthoses and/or shoe modifications continue to be the first line of management, clinical trials assessing the effectiveness of these nonoperative interventions are lacking. The carbon foot plate with an extension under the length of the hallux, called the Morton's extension (ME), is a common intervention. The effects of this device on outcomes and plantar loading alterations during gait have not been studied. The purpose of this study was to assess the effect of the ME on pain, function and plantar loading patterns in patients with hallux rigidus. We hypothesized that use of the ME would result in pain reduction accompanied by modified plantar loading patterns.

NUMBER OF SUBJECTS: 19 subjects (mean [SD] age: 57.3 [7.7] years; BMI: 25.6 [1.9]; M:F, 6:13) who presented to an outpatient orthopaedic clinic with first MTP joint pain and radiographic grade 1-3 hallux rigidus participated.

MATERIALS/METHODS: Self-reported outcomes were assessed using the Foot Function Index-Revised (FFI-R) prior to, and after a 6 week intervention using a carbon foot plate that included a ME, covered with a soft top cover. Plantar loading data (maximum mean pressures (MMP), pressure time integral (PTI) and pressure distribution across the hallux and forefoot regions) were collected using the Pedar in-shoe pressure measurement device as subjects walked in their preferred footwear. A minimum of 30 steps were collected and walking speeds were held constant between conditions (shoe only/shoe + ME insert) and test sessions (pre intervention/post intervention). Statistical analyses were performed (paired t tests and a 2-factor repeated-measures ANOVA) to evaluate difference in pain and function, as well as to compare alterations in plantar loading.

RESULTS: FFI-R scores showed an overall improvement of 22% in total FFI-R scores following a 6-week intervention with ME (T point change; P = .03). This change was primarily driven by improvement in the pain (pre, 40.2; post, 28.4; P < .01) and disability subscales (pre, 40; post, 31; P = .02). Plantar loading patterns indicated a medial shift after wearing the ME insert when compared to shoe-only condition. MMP and PTI were significantly increased under the medial forefoot (P < .01) and hallux regions (P < .01).

CONCLUSIONS: A 6-week intervention with the ME insert showed favorable responses for self-reported pain and function. These changes were associated with alterations in plantar loading patterns that resulted in a shift of pressures to the medial forefoot and hallux. These pressures were found to be similar to those reported in previous studies for subjects without foot pathology.

CLINICAL RELEVANCE: The ME is an inexpensive, over-the-counter intervention that is a viable conservative treatment alternative to surgical intervention.

**OPO2080**

**MEASUREMENT OF ANKLE DORSIFLEXION: A COMPARISON OF ACTIVE AND PASSIVE TECHNIQUES IN MULTIPLE POSITIONS**

Krause DA, Cloud BA, Forster LA, Schrank JA, Hollman JH

Mayo Foundation, Rochester, MN

PURPOSE/HYPOTHESIS: Limited ankle dorsiflexion (DF) range of motion due to restricted gastrocnemius and soleus mobility is associated with a number of lower extremity conditions. A variety of techniques exist to measure ankle dorsiflexion in the clinical setting. Purposes of this study include (1) evaluating intra and interrater reliability of multiple ankle DF measurement techniques and determining the responsiveness, or minimal detectable change (MDC) of each technique, (2) determining if a difference in the amount of measured DF exists between the techniques, and (3) proposing a possible explanation for differences in measured values through electromyography (EMG) analysis. We hypothesized that (1) there would be significantly greater DF with the knee flexed (KF) to 90° as compared to DF with the knee fully extended (KE), (2) DF AROM would be significantly greater than DF PROM given the same knee position, and (3) soleus EMG activity would be minimal with active DF ROM.

NUMBER OF SUBJECTS: Thirty-nine healthy subjects between the ages of 22 to 33 (24.2 ± 2.72) years.

MATERIALS/METHODS: Ankle dorsiflexion of the subject’s dominant leg was measured actively and passively with knee extended, flexed to 90°, and with a modified lunge. A hand held dynamometer was used to standardize the force applied with passive DF ROM. Measurements were taken by 2 examiners on 2 sessions 1 week apart. Surface EMG was used to monitor muscle activity of the soleus and tibialis anterior during the measurements. Statistical analysis included intraclass correlation coefficients to estimate reliability and 1 way-repeated measures (ANOVA) and Bonferroni post hoc testing to determine differences between techniques (α = .05).

RESULTS: (1) Intraobserver reliability ranged from .68 to .89, with the modified lunge resulting in the greatest reliability. Interrater reliability coefficients for the 5 DF test positions ranged from .55 to .79 with the modified lunge the most reliable. MDC for the 5 positions ranged from 6.4° to 7.0°. (2) All 5 testing positions were significantly different from each
other. DF measures in KF were significantly greater than those in KE. (3) DF AROM was greater than DF PROM given the same knee position. (4) The modified lunge resulted in significantly greater ROM than other techniques. (5) Soleus and tibialis anterior EMG data differed across the 5 testing conditions with EMG activity for the soleus and tibialis anterior significantly greater in the AROM and lunge conditions than the passive conditions.

CONCLUSIONS: To maximize reliability, a consistent testing position and examiner should be used when measuring ankle DF. Our MDC results suggest differences of 7° or more represent true change in DF ROM. Active DF ROM measures are greater than measurements taken passively. Reciprocal inhibition does not explain the observed differences.

CLINICAL RELEVANCE: Ankle dorsiflexion measurement may be performed with acceptable interrater reliability. Active measurements and the modified lunge may better represent available dorsiflexion than passive techniques.

OP02081
SURFACE ANATOMY AND NERVE INNERVATION OF THE SINUS TARSI: CADAVER STUDY
Liu H, Forbush S, Wang W
Physical Therapy, University of Central Arkansas, Conway, AR

PURPOSE/HYPOTHESIS: Sinus Tarsi Syndrome (STS) is usually diagnosed by symptoms and direct palpation of this area. However, to date, no study on cadavers has been done to report the surface projection and nerve innervation to the Sinus tarsi (ST). This study purposed to measure the ST surface projections and investigate and describe the nerves which send branches to innervate the ST.

NUMBER OF SUBJECTS: Twenty lower extremities from 10 cadavers without deformity and scars identified in the foot and ankle regions.

MATERIALS/METHODS: With the ankle at 90° of dorsiflexion, the lateral malleolus (LM) was used as a reference plane (RP) in anterior-posterior or direction. A diagonal line (DL) was placed from the LM to the midpoint of the cervical ligament (an easy landmark structure near the middle of the sinus tarsi) and was measured with a digital caliper. The angle between the RP and DL was measured with a protractor. Fourteen samples from 7 cadavers were dissected to identify the ST surface location, and 6 additional samples from 3 cadavers received injection of a blue dye to verify the results from the dissection study.

RESULTS: The sinus tarsi is a cone-shaped space between the talus and the calcaneus opening toward the dorsolateral side of the hindfoot. The diameter of the opening is around 1.15 cm horizontally. The cervical ligament (CL), along with the interosseous talocalcaneal ligaments (ITL), are thick and strong with the CL lying more superficial and anterolateral to the ITL. The CL extends vertically from the inferior lateral neck of the talus to the dorsolateral surface of the calcaneus with average length of 1.25 cm. The distance from the LM to the CL is 5.19 cm. The angle between the RP and DL was approximately 15°. The average width of the interphalangeal joints (IPJs) of the thumbs on the dominant side from 43 healthy physical therapy students was approximately 2.0 cm, so the ST is approximately 2.5 thumb widths (5.19/2.00 cm) away from the LM in an anterior inferior direction (about 15°). With these parameters, the verification study using the blue dye injection showed that fat tissue in the ST was colored blue in all of the samples. The nerve innervations to the ST were studied through delicate dissection. Braches to the ST are mainly from the superficial peroneal nerve (8/14 or 57%), but also were found from the sural nerve (3/14 or 21%), the deep peroneal nerve (2/14 or 14%), and the tibial nerve (1/14 or 7%).

CONCLUSIONS: Using the thumb IPJ of an examiner, the surface projection of the ST could be easily located as approximately 2.5 IPJs away from the LM in an anterior inferior direction. This space receives innervation primarily from the superficial peroneal nerve, but can also be innervated from other nerves branches.

CLINICAL RELEVANCE: This study presents a method for identifying approximate location of the sinus tarsi as well as the clarification of possible nerve innervations to the ST. This information may aid clinicians in examination, differential diagnosis of pain conditions of the lateral foot, and treatment of ankle sprains.

OP02082
ACHILLES TENDINOPATHY: CLINICAL PRACTICE GUIDELINES LINKED TO THE INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY, AND HEALTH
Martin RL, Garcia CR
Physical Therapy, Duquesne University, Pittsburgh, PA

PURPOSE/HYPOTHESIS: The Orthopaedic Section of the American Physical Therapy Association (APTA) has an ongoing effort to create evidence-based practice guidelines for orthopaedic physical therapy management of patients with musculoskeletal impairments described in the World Health Organization’s International Classification of Functioning, Disability, and Health (ICF). The purpose of this project was to recommend evidence-based practice guidelines related to interventions for individuals with Achilles tendinopathy.

NUMBER OF SUBJECTS: N/A.

MATERIALS/METHODS: A systematic search of the MEDLINE, CINAHL, and the Cochrane Database of Systematic Reviews (1967 through February 2009) for any relevant articles related to interventions for individuals with Achilles tendinopathy. As relevant articles were identified, their reference lists were hand-searched in an attempt to identify additional articles that might contribute to the outcome of this guideline. The following definitions were used: strong evidence— a preponderance of level I and/or level II studies support the recommendation; moderate evidence— a single high-quality randomized controlled trial or a preponderance of level II studies support the recommendation; and weak evidence— a single level II study or a preponderance of level III and IV studies including statements of consensus by content experts support the recommendation.

RESULTS: 27 research articles were identified with the following findings noted: An eccentric loading program performed twice daily for 12 weeks with 3 sets of fifteen repetitions both with the knee extended and flexed is recommended based on strong evidence. The use of Low Level Laser Therapy (LLLTT) can be recommended based on strong evidence. Iontophoresis with dexamethasone can be recommended in the treatment of acute (symptoms less than 3 months) Achilles tendinopathy based on moderate evidence. A stretching program can be recommended based on moderate evidence. The use of foot orthotics may be recommended based on evidence only. There is minimal evidence (expert opinion) to support the use of soft tissue mobilizations. There is minimal evidence (expert opinion) to support the use of soft tissue of off-loading taping techniques. The use of a heel lift cannot be recommended based on the evidence available. The use of a night splint cannot be recommended based on the evidence available.

CONCLUSIONS: In the treatment of Achilles tendinopathy there is strong to moderate evidence to support the use of an eccentric loading program, low level laser, iontophoresis with dexamethasone, and stretching exercises. There is weak to minimal evidence to support the use of foot orthotics, soft tissues mobilization, and off-loading taping techniques. Based on evidence available the use of a heel lift or night splint cannot be recommended in the treatment of Achilles tendinopathy.

CLINICAL RELEVANCE: Clinicians can use this information to apply evidence-based practice guidelines for individuals with Achilles tendinopathy.

OP02083
LONGITUDINAL ARCH HEIGHT AND LONGITUDINAL ARCH ANGLE AS RISK FACTORS FOR PLANTAR FASCIITIS: A MATCHED CASE-CONTROL STUDY
Bottoms JW, Nagel CM, Thomas ET, Undem LJ, Schmitt J
Doctor of Physical Therapy Program, St Catherine University, Minneapolis, MN

PURPOSE/HYPOTHESIS: Previous literature has examined several risk fac-
Ten nondisabled participants identified as having limited dorsiflexion and an elevated body mass index (BMI) are primary contributors to plantar fasciitis. However, there has been a lack of consensus regarding other factors such as measures of foot structure and arch height. Recent studies indicate that longitudinal arch height (LAA) and longitudinal arch angle (LAA) are highly reliable measures that correlate strongly with arch structure at midSTANCE. The purpose of this study was to examine LAH, LAA, and other risk factors that may predispose an individual to plantar fasciitis.

**Number of Subjects:** 22 (11 cases, 11 controls).

**Materials/Methods:** Eleven people with plantar fasciitis from local physical therapy clinics and the community (age range, 26-61 years) were recruited to participate in the study. A case was defined as a person with a diagnosis of plantar fasciitis, localized heel tenderness, and worse pain upon standing in the morning. From a sample of convenience, 11 controls were matched on age (±5 years) and gender to each case. Ankle dorsiflexion, LAH, and LAA were measured along with a questionnaire to assess demographics, occupation, and activity variables. Two sample t tests were used to examine differences in continuous variables between cases and controls. Chi-square was used to examine relationships between categorical variables.

**Results:** There were statistically significant differences in passive dorsiflexion ($P = 0.0004$) and BMI ($P = 0.01$) between cases and controls. Differences in participation in impact activities approached significance ($P = 0.07$). However, no statistically significant differences were found between groups in LAH, LAA, arch height ratio, lunge test, or percentage of time spent on feet per day.

**Conclusions:** This study confirmed that elevated body mass index and limited dorsiflexion are risk factors for the development of plantar fasciitis. However, longitudinal arch height and arch angle were not significantly different between cases with plantar fasciitis and healthy controls.

**Clinical Relevance:** Health care professionals may want to consider these risk factors when developing a rehabilitation program. This knowledge may be beneficial in preventing onset or recurrence of plantar fasciitis.

---

**OP02085**

**Impairments and Functional Performance After Total Knee Arthroplasty**

**Alnahdi AH, Snyder-Mackler LR**

**Physical Therapy, University of Delaware, Newark, DE**

**Purpose/Hypothesis:** Total Knee Arthroplasty (TKA) results in long-term pain reduction and patient satisfaction. Despite that, patients continue to have muscle impairments and functional limitation compared with age-matched healthy controls. Patients who underwent unilateral TKA usually report pain in the nonoperated knee that might result from underlying osteoarthritis. Impairments in the nonoperated knee are not usually reported in the literature. The first aim of this study is to compare impairments and self-report of function between limbs 6 months after TKA. The second aim is to determine the best predictor of functional performance 6 months after TKA.

**Number of Subjects:** Twenty subjects with unilateral TKA for osteoarthritis (9 women, 11 men; age, 72.4 ± 6.6 years; BMI, 31.34 ± 7.11) were tested.

**Materials/Methods:** Operated and nonoperated quadriceps maximal voluntary isometric contraction (MVIC) and voluntary activation were assessed using burst superimposition technique. Voluntary activation was quantified using central activation ratio (CAR). Knee range of motion was measured using long arm goniometer. Patient’s self report of knee function was assessed using Knee Outcome Survey-Activities of Daily Living Scale (KOS-ADLs), and Knee pain was measured with a question from KOS-ADLs. The functional performance of subjects was tested using the timed up and go test (TUG), and stair climbing test (SCT). Paired $t$ test was used to detect interlimb differences. A hierarchical regression was used to determine predictors of functional performance. Operated MVIC, operated knee flexion ROM, knee pain, and operated knee extension ROM were used to predict the dependant variables (TUG, SCT). Significance level was set at $0.05$.

**Results:** Quadriceps was significantly stronger in nonoperated side as compared to the operated side ($P = 0.048$). Nonoperated knee scored higher in KOS-ADLS as compared to the operated knee ($P = 0.019$). Nonoperated knee had higher flexion and extension ROM ($P = 0.001, P < 0.001$) than the operated knee. There was no interlimb differences in CAR ($P = 0.15$) and knee pain ($P = 0.69$). Operated quadriceps strength was the strongest predictor of TUG (R squared = 0.27, $P = 0.02$), SCT (R squared = 0.33, $P = 0.008$). Adding operated knee flexion, knee pain, and operat-
ed knee extension did not significantly added to the model that predicts either TUG or SCT.

CONCLUSIONS: In patients 6 months after TKA, Operated knee is more impaired than nonoperated knee in terms of quadriceps strength, flexion and extension joint mobility. Patients perceived that the operated knee limits their daily activities more than the nonoperated knee. Results showed that quadriceps strength is the best predictor of functional performance in patients 6 months after TKA.

CLINICAL RELEVANCE: Quadriceps strength is still impaired 6 months after TKA, so physical therapist should encourage their patients to continue their exercise programs after being discharged from physical therapy. Quadriceps strengthening exercises should be emphasized because of the strong relationship between quadriceps strength and functional performance.

SEX DIFFERENCES IN KINEMATICS AND KINETICS DURING A ROTATIONAL JUMP LANDING AND UNANTICIPATED CUTTING MANEUVER


Kinesiology, The University of Toledo, Toledo, OH; Ohio Orthopaedics and Sports Medicine, Findlay, OH

PURPOSE/HYPOTHESIS: Neurromuscular control of the lower extremity has been proposed to be the primary contributor to the significantly increased risk for ACL injury exhibited by females. Multiple prevention programs have been proposed in the literature with varying effects. Interestingly, those prevention programs that appear to significantly decrease the risk of ACL injury employ technical instruction on landing from rotational jumps. However there exists a significant knowledge gap in the literature with respect to rotational jump landing. Thus the purpose of this study was to quantify the kinematics and kinetics of the knee during a rotational jump landing unanticipated cutting maneuver (RJLUC), with specific application to gaining insight into the ACL injury risk paradigm.

NUMBER OF SUBJECTS: Twenty females (21.3 ± 0.733 years of age; height, 65.63 ± 3.07 in; weight, 144.2 ± 19.81 lb) and nineteen males (age, 21.37 ± 2.06 years; height, 70.96 ± 3.39; weight, 177.32 ± 33.08 lb) were recruited from The University of Toledo and Toledo community. All participants reported a minimum of 3 years of experience in basketball, volleyball, or soccer.

MATERIALS/METHODS: A standard 3-D video analysis was completed. Subjects rotated approximately 135° during the jump and upon reaching the vertical jump marker a personal computer program provided visual stimuli for the direction of cut. Subjects completed 12 RJLUC trials at 50% of their maximum rotational jump height during which video and force data were collected. Peak knee flexion, genu valgum, vertical GRF, and proximal anterior tibial shear force at the knee were calculated for the landing phase of the RJLUC. Kinematic data were also calculated during preparatory phase and initial contact of landing. Statistical Analysis: A 1-way MANOVA was run as well as an intraclass reliability analysis within SPSS v15.0.

RESULTS: Females demonstrated significantly less knee flexion during the preparatory phase, $F_{gender} = 9.77, P = .003$ (mean, $-0.34° ± 4.38°$ versus $-6.00° ± 6.73°$), initial contact, $F_{gender} = 18.44, P = .001$ (mean, $-3.18° ± 4.14°$ versus $-11.05° ± 7.01°$), and peak knee flexion, $F_{gender} = 10.83, P = .002$ (mean, $-61.82° ± 9.64°$ versus $-72.02° ± 9.71°$). Males demonstrated significantly greater PPATSF $F_{gender} = 7.349, P = .010$ (mean, 9.53 ± 1.88 versus 7.63 ± 2.44 N). Intraclass correlation coefficients (ICCs) were above 0.744 for all kinematic variables and above 0.456 for the 2 kinetic variables. All variables demonstrated significant intraclass reliability ($P = .001$).

CONCLUSIONS: The RJLUC is a reliable high risk maneuver that may depict the potential neuromuscular control differences between sexes. Further research needs to be completed on the RJLUC to determine its exact implications to the ACL injury paradigm.

CLINICAL RELEVANCE: Replicating the temporal and spatial parameters surrounding ACL injury is a worthwhile goal of any ACL injury prevention program. The results of this study suggest that technical instruction on landing from a rotational jump is warranted.

EFFECT OF TREKKING POLES ON FUNCTION AND COMMUNITY AMBULANCE COMPLIANCE IN A PATIENT WITH BILATERAL TRANSTEMORAL AMPUTATIONS

Bezkor E, Rao S

Adult Outpatient Physical Therapy, NYU Langone Medical Center, New York, NY; Physical Therapy, NYU, New York, NY

BACKGROUND AND PURPOSE: Community ambulation and decreased reliance on a wheelchair are important components to the successful rehabilitation of a patient with bilateral transfemoral amputations. Patients may be reluctant to ambulate in the community secondary to the increased energy expenditure, imbalance and stigma that may be associated with assistive devices. The purpose of this case is to describe the improvement in function and community ambulation compliance that occurred when a patient with bilateral transfemoral amputations used trekking poles versus lofstrand crutches.

CASE DESCRIPTION: The patient was a 33-year-old male, status post bilateral transfemoral amputations secondary to a motor vehicle accident. He presented to outpatient physical therapy 8 weeks postinjury and made steady gains in functional mobility and prosthetic training. However, at 17 weeks postinjury the patient’s progress plateaued, evidenced by limited ability to ambulate with nonarticulating short legs to 120 ft, stand-by assist, bilateral lofstrand crutches. Intervention. Patient was switched to trekking poles over 3 weeks. Patients’ response to trekking poles was compared to baseline walking using lofstrand crutches. Outcomes were assessed with standardized tests including the Dynamic Gait Index, Timed Up and Go and 6-Minute Walk Test. A modified version of the Prosthetic Evaluation Questionnaire (PEQ) was used to assess the patient’s satisfaction with his upper extremity assistive devices. The International Physical Activity Questionnaire (IPAQ) was used to assess physical activity.

OUTCOMES: Preintervention assessments including the Dynamic Gait Index (11/24), Timed Up and Go (23 seconds), 6-Minute Walk Test (1 break, 160 ft, 27 bpm increase in HR and a score of 8 on the Modified Borg Scale) supported the clinical impression that patient experienced significant disability in ambulation. Following 3 weeks use of trekking poles, improvements in functional ambulation ability were noted, reflected in higher Dynamic Gait Index score (14/24), lower Timed Up and Go (19 seconds) and higher 6-Minute Walk Test (1 break, 200 ft, 24 bpm increase in HR and a score of 5 on the Modified Borg Scale). On the PEQ, the patient’s cumulative evaluation score of the lofstrand crutches was 1342 with appearance, frustration, utility and satisfaction scores of 62, 116, 50, and 105. The trekking poles were scored at 1781 with appearance, frustration, utility and satisfaction scores of 100, 200, 86 and 199. The IPAQ indicated that the patient increased community ambulation from once a week with the lofstrand crutches to 5 times a week with the trekking poles.

DISCUSSION: The improved perceived appearance and utility of the trekking poles may encourage patients to be more compliant with ambulating in the community and thus have improved functional outcomes. Preliminary findings may suggest that trekking poles offer a valuable alternative to improve functional ambulation in individuals with bilateral transfemoral amputations.

INTRARATER RELIABILITY AND CONCURRENT VALIDITY OF HAND-HELD DYNAMOMETRY TO MEASURE HIP FLEXOR STRENGTH AND ENDURANCE

Ferguson RC, Canavan PK, Cahalin L

Physical Therapy, Northeastern University, Boston, MA
Degenerative conditions of the hip are a common occurrence. The purpose of this case study was to examine the intrarater reliability and concurrent validity of handheld dynamometry (HHD) compared to standard computerized dynamometry (SCD) during an isometric maximal voluntary contraction (MVC) and a muscular endurance test (ET) of the hip flexors.

**Number of Subjects:** Twelve healthy subjects (6 men and 6 women) with a mean age of 21 ± 2 years.

**Materials/Methods:** Strength was randomly measured via a unilateral isometric hip flexion MVC using SCD (Biodex) and a HHD break test (Lafayette). Hip flexion ET was performed with SCD and HHD following each hip flexion MVC. Five minutes of rest separated the hip flexion MVC and the ET and 20 minutes of rest separated the next test of MVC and ET using the testing device not used initially. A third hip flexion MVC and ET via HHD were performed 5 hours after the initial tests. The SCD and HHD isometric MVC tests were performed supine using standard methods and 3 MVCs. The SCD ET consisted of 30 supine maximal isokinetic hip flexion contractions at 180°/s and the HHD ET consisted of 30 supine isometric hip flexion contractions with Velcro weights representing 40% of peak MVC. The HHD ET started and ended with 3 rapid MVC tests via HHD yielding an endurance ratio (ER) of 3 initial to 3 final MVCs. Ratings of perceived exertion (RPE) and pain were examined at rest and at peak during the ETs with OMNI RPE and pain scales, respectively. Weekly exercise and demographics were obtained.

**Results:** The mean ± SD ER of the first and second HHD ET were similar (93.4 ± 5.3 and 92.4 ± 4.3, respectively) yielding a nonsignificant difference (P = .28), high degree of correlation (r = .81, P = .001), and high ICC (.99). The mean ± SD resting RPE and pain levels before the first and second HHD ET were 2.8 ± .25 versus 2.3 ± .21, respectively. The mean ± SD peak RPE and pain levels during the first and second HHD ET were 5.3 ± 2.0 versus 2.7 ± 1.8 and 3.0 ± 2.8 versus 2.4 ± 2.1, respectively. The increase in RPE and pain during the HHD ET was significant (P < .001) during the first and second HHD ET. The HHD ER was significantly correlated to peak RPE (r = .76, P = .004), but not peak pain. The HHD ER was significantly correlated to weekly exercise (r = −.66, P = .01). Concurrent validity of the SCD ET and HHD ET was poor due to the absence of hip flexor fatigability using the above SCD ET protocol. Concurrent validity of HHD and SCD isometric hip flexion MVC was good with no significant difference between HHD and SCD MVC (P = .20), high degree of correlation (r = .70, P = .01), and high ICC (.99).

**Conclusions:** The high reliability of the HHD ET, significant increase in RPE, significant correlation between the HHD ER and peak RPE but not pain, and discriminatory ability of weekly exercise make the HHD ET of the hip flexors clinically useful.

**Clinical Relevance:** The use of HHD for MVC and ET of hip flexors appears warranted, but future investigation of older subjects and other muscle groups is needed.

**Op02090**

**The Relationship of Various Psychometric Measures and Outcomes in Total Knee Patients**


Health and Sport Science, University of Dayton, Dayton, OH; Physical Therapy, Kettering Medical Center, Dayton, OH

**Purpose/Hypothesis:** It was the aim of this study to examine relationships that may exist between certain psychometric measures and patient functional outcomes.

**Number of Subjects:** Forty-four male and female subjects between 50 and 80 years old, undergoing their first TKR.

**Materials/Methods:** The psychometric instruments included the Fear Avoidance Beliefs Questionnaire, adapted to knee patients; the Multi-dimensional Health LOCus of Control (MHLLOC) scales A and C; and the World Health Organization Major Depression Inventory (MDI). The functional outcomes instruments were the Physical Therapy Improvement in Motion Assessment Log (OPTIMAL) and the Western Ontario and McMaster University Osteoarthritis Index (WOMAC). After obtaining informed consent, the subjects completed and mailed a preoperative set of instruments. Six weeks postsurgery a member of the research team called the participant and reminded them to complete the postoperative set of forms. Raw data were entered into an access database and subscale results were calculated using queries. Analysis of Data: Results on each psychometric instrument were dichotomized into high and low-scoring groups. Change in functional subscale scores was obtained by subtracting postoperative scores from preoperative scores. Multivariate general linear model analysis was conducted using SPSS 16.0 to explore correla-
tions between the psychometrics and functional outcomes. A priori significance was set at .05.

RESULTS: Lower extremity difficulty (LEDiff), a subscale of the OPTIMAL was the only functional scale to show significant differences from psychometrics. The group that scored high on the MDI were most significant (P<.001). Three of the MHLC (form C) subscales showed significant differences with LEDiff: high internal (P<.004), low significant other (P<.005), and high internal (P<.004).

CONCLUSIONS: Patients who believe that responsibility for improvement rests within (ie, high internal locus of control, low chance and low significant other) made greatest improvements in lower extremity difficulty pre to postoperatively. The greatest gains in lower extremity difficulty were obtained by those who scored higher on the WHO MDI.

CLINICAL RELEVANCE: If functional outcomes are influenced by psychometrics, then it may be possible that there is an optimal postoperative venue suggested by results of psychometric instruments.

**OPO2091**

SCREENING COMPLICATED PATIENTS WAITING FOR A TOTAL KNEE ARTHROPLASTY MAY PROVIDE INSIGHT INTO WORSENSING CONDITION

Danks KA, Hunter-Giordano AO, Schmitt LA, Manal T

Physical Therapy, University of Delaware, Newark, DE

BACKGROUND AND PURPOSE: Preoperative quadriceps strength has been shown to be predictive of functional outcomes in patients with total knee arthroplasty (TKA). Undergoing a TKA prior to significant quadriceps weakness may maximize postoperative recovery (Mizner 2005). When complicated by other injuries, strength may be paramount. This case describes quadriceps strength changes in a patient with L medial knee osteoarthritis (OA), anterior cruciate ligament (ACL) injury, and quadriceps weakness.

CASE DESCRIPTION: The patient was a 49-year-old male with a 4-5 year history of L knee OA aggravated by a fall at work 2 months prior to physical therapy referral. He had 2 L knee arthroscopic surgeries 23 years ago due to infection. MRI revealed a medial meniscal tear and partial ACL tear. X-rays showed significant L medial knee OA. A cortisone injection reduced his pain to a 4/10 at worst. As a result of pain and instability, he reported limited function; difficulty with stairs, prolonged standing, and the heavy manual labor required of his job. At evaluation, the patient presented with patellar hypomobility in all directions; AROM: 0°–107°; girth at mid patella, R 43.5 cm and L 46 cm; and a quadriceps maximal volitional isometric contraction (MVIC) index of 78% (R 1016 N, L 781 N). KT arthrometer registered R 6 mm and L 9 mm, indicating ACL tear. The patient was found to be limited by pain, strength, patellar hypomobility, swelling, and knee instability. Physical therapy included ROM activities, stretching, patellar mobilizations, quadriceps strengthening with and without functional electrical stimulation (FES), neuromuscular electrical stimulation (NMES), isokinetics, perturbation training, and modalities for pain. The patient also received a GII medial unloading brace. After 14 physical therapy sessions the patient’s quadriceps MVIC index was 57% (R, 1101 N; L, 638 N). Intense physical therapy continued. The patient’s quadriceps MVIC index a week later was 53% (R, 1101 N; L, 587 N).

OUTCOMES: Evidence suggests that quadriceps strength gains in ACL deficient knees are difficult (Hurd 2007). In 7 weeks, the patient had a 200 N decline in L quadriceps strength despite concentrated efforts at strengthening. To avoid further decline we suggested that the patient seek surgical intervention, a L TKA was performed 3 months later.


**OPO2092**

DIAGNOSIS AND TREATMENT OF FEMOROACETABULAR IMPINGEMENT: A CASE STUDY

Donahue KA

Arizona OrthoSports Physical Therapy, Glendale, AZ

BACKGROUND AND PURPOSE: Femoroacetabular impingement (FAI) is classified as abnormal contact stresses with the potential for joint damage around the hip due to a bony deformity or spatial malorientation of the femoral head or head/neck junction or acetabulum. These abnormalities combined with terminal and/or vigorous hip motion can lead to repetitive collisions that damage the soft tissue (labrum and/or cartilage) and osseous structures at the acetabular rim. The purpose is to describe the clinic presentation, treatment and outcome of a patient who presents with FAI.

CASE DESCRIPTION: A 58-year-old male with complaints of deep hip pain. He complained of 3/10 pain at rest, increased to 8/10 with walking, running and lifting. He was unable to walk greater than 15 min without 8/10 pain. He reports history of self described hamstring tightness and has been unable to tie his shoes for many years. Performing stretching program to improve right hip flexibility for the past 20 years. Posture: anterior pelvic tilt, parasymmetrical abdication, abdication of right hip and tibial lateral rotation. Forward bending: right hip flexion less than 90°. Single leg stance right hip less than 0° extension. Right hip AROM/PROM: 0°/0° medial rotation, 25°/25° lateral rotation, 0°/5° extension, –12°/0° adduction, 15°/20° abduction, and flexion 80°/85°. Right hip strength (within available range of motion): 3/5 iliotibialis, 4/5 glutaeus maximus, 3/5 glutaeus medius. Short TFL/ITB. Gait demonstrates marked loss of right hip ROM with decreased extension, increased abduction and trendelenburg. Patient was seen for 6 treatments over 3 months. Treatment was focused on mid-range strengthening exercises while avoiding movement into end ranges, decreasing lateral rotation and abduction with walking. Treatment included T-band hip MR/ LR, proper gait and stride length utilizing a Precor Elliptical, prone hip extension with knee flexion, side step ups, lower and upper abdominal strengthening and sidleline hip abduction with extension. His gait was modified to decrease stride length with walking, increase femoral medial rotation and decrease tibial lateral rotation. He was instructed to discontinue running and stretching program for the right hip.

OUTCOMES: One month (2 visits) 30% decrease in hip pain with walking for 40 minutes. Two months he returned to the gym, utilizing elliptical with 75% improvement in symptoms (3/10 maximum discomfort). Three months later (6 visits) he demonstrated a mild trendelenburg, abolishment of tibial lateral rotation and improved hip extension to neutral. Walking 5 miles per day with 0/10 pain. AROM improved to 5° hip extension, 90° hip flexion, 0° medial hip rotation and 0° hip adduction. Final visit he reported abolishment of symptoms and returned to all activities. He had discontinued all running and stretching programs.

DISCUSSION: Defined standards of assessment and treatment need to be developed to provide high accuracy and precision in diagnosis. Early recognition and proper intervention with exercise modification can decrease the incidence of OA at the acetabular rim and improve function.

**OPO2093**

QUADRICEPS FEMORIS AND HIP EXTENSOR STRENGTHENING USING A LATERAL STEP-UP EXERCISE


Physical Therapy, University of South Dakota, Vermillion, SD

PURPOSE/HYPOTHESIS: To determine if a lateral step-up exercise can be used for strengthening the quadriceps femoris or hip extensor muscles.

NUMBER OF SUBJECTS: Twenty-three healthy subjects with no lower extremity pain or injury participated in this study. Thirteen subjects were in a control group and 10 subjects were in an exercise group. The mean age of the subjects was 25.7 years.
MATERIALS/METHODS: The subjects were strength tested before and after the exercise group trained for 9 weeks. The peak-torque and average power output for the quadriceps femoris and hip extensor muscles were determined isokinetically on the Cybex Norm at speeds of 60°/s and 120°/s. The 10 RM for the unilateral leg press exercise was also measured. During each exercise session, the subjects in the exercise group performed 3 sets of lateral step-ups in the training range of 8-12 RM. The resistance was adjusted by using steps of 20, 30, or 40 cm in height and by adding weights to a weight vest. The exercise program consisted of a mean of 15.4 (range of 13-17) exercise sessions spread over a 9-week period. The control group carried on with normal activities and did not perform any lower extremity strengthening exercises during the study period. Significance was determined with a paired t test (P<.05).

RESULTS: There were no significant changes in any of the strength measurements for those in the control group or for the untrained left lower extremity of the exercise group. For the right lower extremity of the exercise group there was a significant improvement in lateral step-up and leg press performance demonstrated by 26% (P = .016) increase in the total work performed during the step-up exercise and 11% (P = .001) increase in the 10 RM of the leg press exercise. For the right hip extensor muscles, isokinetic testing revealed an 18% (P = .007) and 29% (P = .009) increase in peak torque at 60°/s and 120°/s respectively and also an increase average power output of 24% (P = .01) and 34% (P = .007) at those same speeds. There were 5% to 9% improvements in the isokinetic tests for the quadriceps femoris, but these results were not statistically significant.

CONCLUSIONS: The lateral step-up exercise performed in a strength training range of 8 to 12 RM over a 9-week period did not demonstrate a significant strengthening effect for the quadriceps femoris muscles. However, there was significant improvement in hip extensor muscle strength measurements.

CLINICAL RELEVANCE: Lateral step-up exercises are often used in rehabilitation of the knee to help improve muscle performance. These exercises may provide endurance training, but do not seem to be suitable for strengthening the quadriceps femoris even when performed in what is considered a strengthening training range. Instead, this exercise may be better suited for improving the strength of the hip extensors.

OP02095

THE EFFECTS OF JUMP STRETCH FLEXBAND STRETCHING AND STATIC STRETCHING ON HAMSTRING FLEXIBILITY
McCann K, Scheidt K, Snyder A, Zimmerman M, Encheff J
University of Findlay, Findlay, OH

PURPOSE/HYPOTHESIS: Jump Stretch FlexBands are used for a stretching technique known as dynamic variable resisted active isolated ballistic stretching (DVRAIBS). The motion uses ballistic stretching while the band’s tension and resistance against a muscle group incorporates proprioceptive neuromuscular facilitation. Studies for lengthening the hamstrings are very abundant in the area of static stretching, and this seems to be a proven way to increase flexibility. Since few studies have been done on DVRAIBS, it was necessary to look at this type of stretching and compare it to static stretching. The purpose of this study, then, was to compare changes in hamstring length in 2 groups of college football players over a 6-week period. One group used Jump Stretch FlexBands during a stretching program, while the other group performed traditional passive static stretching with partners.

NUMBER OF SUBJECTS: A total of 30 male college football players were recruited and randomly divided into a test group (Flexband) (n = 15; age, 20.61 ± 1.19 years; 92.18 ± 10.46 kg) and a control group (Static) (n = 15; age, 19.83 ± .985 years; 95.95 ± 11.02 kg).

MATERIALS/METHODS: Prior to starting a 6 week stretching program, pre-test bilateral hamstring flexibility of all 30 subjects was measured via the Sit and Reach Test (SRT) and end range passive range of motion goniometric measurements at the knee during a supine straight leg raise. All subjects then stretched their hamstrings 4 times per week for 6 weeks using either Jump Stretch FlexBands or passive static stretching. After 6 weeks, subjects were re-tested on the SRT and goniometric measurements were again taken at the knee to determine changes in hamstring length.

RESULTS: Both groups demonstrated improved hamstring flexibility after 6 weeks of stretching as measured by both the SRT and goniometry. The group using the FlexBands for training demonstrated a significant improvement over the control group in left hamstring flexibility only (P<.05). No differences between groups were identified in right hamstring flexibility or the SRT.

CONCLUSIONS: The results of this study indicate that both methods of stretching led to significant gains in hamstring flexibility in a group of college football players after a 6-week stretching protocol.
**LOCAL INTRINSIC FACTORS THAT PREDICT PAIN AND FUNCTION IN KNEE OSTEOARTHRITIS**

**Gibson K, Sayers SP, Minor MA**

**Physical Therapy, University of Missouri, Columbia, MO**

**PURPOSE/HYPOTHESIS:** Knee osteoarthritis (OA) is one of the most common conditions affecting the quality of life of older adults. Pain and decrease in function are common problems associated with the disease. The study of knee OA is made difficult by the inability of researchers to effectively characterize the subject pool by factors that impact the mechanical environment in which the knee functions. These local intrinsic factors are difficult to measure because of high cost, the need for special equipment or training, and the time of necessity to collect the data. Furthermore, there has been little research to guide investigators when deciding what factors might be important to include in their studies. The purpose of this study was to make an evidence-based recommendation for the inclusion of specific factors in the future study of knee OA.

**NUMBER OF SUBJECTS:** Forty-six subjects with knee osteoarthritides were examined.

**MATERIALS/METHODS:** Observed function was measured by the Timed Chair Rise Task. Self-reported function was measured by the WOMAC Function Scale and pain was measured by the WOMAC Pain Scale. Local intrinsic factors measured included Varus/Valgus Alignment, A/P Laxity, Proprioception, Knee Extension Strength by Bodyweight, Knee Flexion Strength by Bodyweight, and Knee ROM.

**RESULTS:** Factors were recommended for inclusion in future research if they were significantly correlated with at least 1 measure of function or pain and if the factor made a significant unique contribution to a regression model when more than 1 local intrinsic factor was correlated with the same measure of function or pain. Extension Strength by Bodyweight was correlated with observed function ($r = 0.32, P = 0.03$). Varus/Valgus Alignment was correlated with pain ($r = 0.48, P = 0.001$) and self-reported function ($r = 0.38, P = 0.009$). A/P Laxity was also correlated with pain ($r = 0.30, P = 0.4$) and self-reported function ($r = 0.37, P = 0.01$). Knee ROM was correlated to self-reported function ($r = 0.35, P = 0.016$). Varus/Valgus Alignment made a significant contribution to prediction of pain ($P = 0.003$), A/P Laxity to self-reported function ($P = 0.004$), and Knee ROM to self-reported function ($P = 0.008$).

**CONCLUSIONS:** Findings from this study suggest data regarding Varus/Valgus Alignment, A/P Laxity, Knee Extension Strength, and Knee ROM should be collected in future study of knee OA.

**CLINICAL RELEVANCE:** Studies examining the effect of exercise in individuals with knee OA typically have utilized broad inclusion criteria, often based solely on the type of arthritis and/or joint involved. The ability to adequately characterize individuals with knee OA with respect to the mechanical environment of the joint will allow researchers to analyze outcome data in a more individualized fashion. These data could ultimately assist researchers in the production of more individualized and effective exercise programs for knee OA.

**TREATMENT OF THE CALCANEUS FOR LATERAL KNEE PAIN AND LIMITED RANGE OF MOTION: A CLINICAL DECISION MAKING PROCESS**

**Tonley J, Kohout M**

**Kaiser Permanente, Beverly Hills, CA**

**BACKGROUND AND PURPOSE:** The purpose of the case study is to describe the clinical decision process related to the treatment of limited knee flexion secondary to lateral knee pain in a patient that was nine months post ACL reconstruction using a hamstring graft.

**CASE DESCRIPTION:** The patient is a 29-year-old female dancer that suffered a rupture of her right ACL and medial meniscus tear on 5/5/07. She underwent an ACL reconstruction on 8/17/07. She had 39 PT visits for strengthening, ROM and functional training. She had been issued a JAS splint for range of motion during this period of time. She was discharged from care on 2/01/08 due to change of insurance. ROM at discharge was AROM 131° and PROM, 140° with pain 7-8/10 on aVAS. She was referred back to PT on 4/24/08 with a referral of post-op knee stiffness secondary to scar tissue.

**CLINICAL RELEVANCE:** The Jump Stretch FlexBand may be a more dynamic alternative method of stretching for athletes that yields similar results as static stretching and does not require a partner. Future studies may want to compare injury rates between 2 similar groups after a 6-week protocol or investigate the use of Jump Stretch FlexBands for stretching in other populations.

**PATTERN AND PREDICTORS OF EARLY FUNCTIONAL RECOVERY IN CLINICAL PRACTICE AFTER HIP ARTHROPLASTY**

**Kirkness C, Fritz JM**

**Physical Therapy, University of Utah, Salt Lake City, UT**

**PURPOSE/HYPOTHESIS:** Gender and preoperative baseline functional status have been identified as predictors of postoperative total hip arthroplasty (THA) recovery in observational studies. In clinical practice, preoperative functional status is often unknown. There is no published evidence of early recovery after THA for patients seeking and attending physical therapy in the outpatient setting. An understanding of the recovery process within a usual clinical practice will inform clinicians of predictors available in clinical practice that may aid in the treatment plan. The purpose of this study was to model the early recovery of lower extremity function in postoperative THA patients attending physical therapy in an outpatient clinic and to use gender, age, and number of visits as predictors of recovery.

**NUMBER OF SUBJECTS:** A total of 117 (62 female, 55 male) postoperative THA patients were identified, mean age of 61 years (SD, 12), range, 35–91 years.

**MATERIALS/METHODS:** Patient data were extracted from the Intermountain Healthcare electronic medical record physical therapy database from October 1, 2004 through April 30, 2009. Patients were >18 years old with THA defined by ICD-9 codes. Usual care procedures involved the administration of the Lower Extremity Function Scale (LEFS) at the initial assessment, interim and discharge from treatment. Each patient had a minimum of 3 assessments that occurred at varying times within 20 weeks post-THA. Average growth curves and individual variations in the pattern were characterized using hierarchical linear modeling. Predictors of recovery were sequentially modeled after validation of the basic developmental models. Gender, age, and number of physical therapy visits were investigated as predictors.

**RESULTS:** The majority (79%) of patients improved lower extremity function as defined by the minimally clinical important difference (MCID, 9). The curvilinear slopes of recovery were similar between males and females; females had lower functional status than males overall. Gender was a predictor of functional status ($P = 0.041$); a second-degree polynomial growth term (weeks squared) provided a reasonable fit for the data over the study interval as the rate of improvement decreased over time. Growth curves were generated that predict the rate and amount of change in LEFS scores.

**CONCLUSIONS:** After THA surgery women enter and are discharged from outpatient physical therapy with lower function status than men, although the rate of recovery is similar between groups. Functional status steadily improved over the 20 weeks postsurgery. Modeling change in clinical practice utilizing outcomes measures acquired through usual practice can feasibly and adequately serve to guide decisions in the management of THA rehabilitation.

**CLINICAL RELEVANCE:** Clinicians may use these findings from clinical data to estimate the predicted rate of functional improvement and maximal functional improvement following THA that may be seen in an outpatient setting.
Meralgia Paresthetica is a mononeuropathy of the lateral femoral cutaneous nerve characterized by dysesthesia and burning in the right antero-lateral thigh. The incidence rate in the general population is 4.3 per 10,000, with a variety of reported etiologies including mechanical compression and laparoscopic inguinal hernia repair. Diagnosis can be made by clinical examination and nerve conduction study. Evidence based treatments do not include physical therapy. The purpose of this case report is to describe examination and intervention used to treat a patient with an onset of meralgia paresthetica following hernia repair.

**CASE DESCRIPTION:** The patient was a 55-year-old male with a 1 year insidious onset of pain, decreased sensation and burning in the right anterolateral thigh. Numeric pain rating scale (NPRS) was 4/10 with rapid position changes increasing the pain to 10/10. He reported inability to mow his yard. The patient underwent a successful laparoscopic inguinal hernia repair on the right 2 years earlier. The neurological examination was normal, but light touch sensation over the antero-lateral thigh was decreased. Palpation to the inguinal hernia repair site was thickened, locally painful and reproduced the leg pain. Lumbar and thoracic spine palpation was locally painful without referred leg pain. Nerve conduction study showed a prolonged sensory distal latency to the right lateral femoral cutaneous nerve. The main outcome instruments were the NPRS and Lower Extremity Functional Scale. The patient was treated 7 times over 5 weeks. The intervention included manual therapy directed at the thoracic spine and inguinal region followed by mobility exercises to both areas. The patient was taught home-based exercise to supplement clinical interventions.

**OUTCOMES:** The patient demonstrated improvement beyond the minimal clinical important differences for pain rating and function. The NPRS improved from 4/10 to 0/10 with no exacerbations. The lower extremity functional scale improved 65 points, from 33% to 98%. The area of decreased sensation was significantly reduced. He was able to mow his yard and at 1 month follow-up was fully functional.

**DISCUSSION:** The surgical history and painfully thickened scar with symp-tom reproduction in the leg suggests a possible etiology of postoperative scar forming following laparoscopic hernia repair. This case report presumably describes successful physical therapy intervention for a patient with meralgia paresthetica. No causal relationships can be drawn from this report. Further studies should be done to potentially identify a subgroup of patients with meralgia paresthetica likely to benefit from physical therapy.
Osteoarthritis (OA) of the hip is a common problem affecting adults greater than 55 years of age. There is no cure for hip osteoarthritis, but many treatment options are available. Conservative treatment options such as lifestyle modification, weight loss, and physical therapy, including manual therapy and therapeutic exercises, are shown to be effective. Surgical intervention is usually recommended after trial of conservative management. The purpose of this study was to compare specific measurements and activity levels between patients with hip osteoarthritis who elect to have surgical intervention compared to those undergoing nonoperative treatment and compared to a control group.

**NUMBER OF SUBJECTS:** The experimental group consisted of subjects who have been diagnosed with hip OA by an orthopaedic surgeon and further divided into surgical (n = 15) and nonsurgical (n = 12) groups. The control group (n = 13) consisted of subjects recruited from the hand clinic and had no history of hip pain. Further data are currently being collected to gain more subjects, particularly in the control group.

**MATERIALS/METHODS:** A convenience sample of patients over age 50 seen for their initial visit to an orthopaedic surgeon for hip pain were recruited. Subjective information gathered were pain, using a numeric pain scale, and the Harris hip score. Objective data measured were range of motion using a standard goniometer, hip strength using a hand held dynamometer, hip joint space as seen on an radiograph using a standard ruler, and body mass index calculated from the patient’s height and weight. Similar objective measurements were gathered from a control group of similar age patients seen for hand conditions.

**RESULTS:** When compared to the control group, the hip osteoarthritis group demonstrated decreases in hip flexion ROM (P = .008), hip abduction ROM (P = .01), hip internal rotation (IR) ROM (P = .001), hip flexion strength (P = .02), hip abduction strength (P = .01), and hip IR strength (P = .003). With respect to the nonsurgical group, the surgical group presented with decreases in joint space (P = .03), Harris Hip score (P = .001), hip flexion ROM (P = .008), and hip IR ROM (P = .001). No significant difference were found between BMI of the 3 groups or in pain scale or strength between operative and nonoperative groups.

**CONCLUSIONS:** Joint space narrowing, Harris Hip score, hip flexion ROM, and hip IR ROM was found to be significant factors for determining surgical versus nonsurgical intervention. The findings are consistent with the Cyriax capsular pattern for the hip which consists of limitations in internal rotation, flexion, and abduction. The results are also consistent with a clinical prediction rule on diagnosis of hip OA such that subjects with osteoarthritis who are recommended operative treatment have less than 25° of hip internal range of motion.

**CLINICAL RELEVANCE:** These results may indicate that conservative interventions including hip range of motion activities could prevent or delay surgical intervention.

**OP02013**

**PREDICTING SELF-REPORTED DISABILITY IN PATIENTS WITH TIBIOFEMORAL OSTEOARTHRITIS**

Saliba S, Pietrosimone BG, Ingersoll CD

Human Services, University of Virginia, Charlottesville, VA

**PURPOSE/HYPOTHESIS:** Many factors have been hypothesized to contribute to self-reported disability in people with tibiofemoral osteoarthritis (TFOA). Additionally, these factors may contribute differently at various stages of the disease state as well as between sexes. The ability to predict disability from measured characteristics may help guide therapeutic interventions. The aim of this study was to predict disability in patients with tibiofemoral osteoarthritis (TFOA) using measures of dynamic quadriceps strength and activation, exercise habits, physical activity level, pain, knee moments during gait, as well as to determine if level of joint deterioration and sex alter the predictive model.

**NUMBER OF SUBJECTS:** Thirty-six patients (15 males, 21 females; age, 59.9 ± 11.6 years; height, 171.2 ± 9.2 cm; mass, 84.3 ± 18.9 kg; body mass index (BMI), 28.9 ± 6.9) with TFOA participated in this study.

**MATERIALS/METHODS:** Kellgren-Lawrence score, age, BMI, quadriceps activation, knee extension torque, leisure-time exercise, level of activity, peak external knee flexion moment during gait, pain during a maximal voluntary isometric knee extension contraction (MVIC) and pain during a 20 cm step-up were measured for each participant. Disability was evaluated using the total of the 3 subsets (pain, stiffness and function) of the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). A stepwise regression model was used to predict disability for the entire sample, people with high (Kellgren-Lawrence, >3) and low (Kellgren-
Dynamic stiff-knee gait in patients pre and post total knee arthroplasty

Weatherly K, Vardaxis V, Mahoney C
Physical Therapy, Des Moines University, Des Moines, IA; Iowa Orthopaedic Center, PC, Mercy Hospital, Des Moines, IA

Purpose/hypothesis: Patients with knee osteoarthritis demonstrate a “stiff knee” pattern during gait that is usually attained by co-contraction of the knee flexors and extensors. Improvements in pain, ROM, strength and function following total knee arthroplasty (TKA) surgery may not directly translate into changes in habitual lower extremity gait mechanics developed pre-TKA. The persistence of a “stiff knee” pattern during gait could have detrimental implications long term. The purpose of this study is to compare the dynamic knee joint stiffness of patients’ pre and 3 months post-TKA during the loading response phase of gait to controls in order to determine if the “stiff knee” gait pattern persists following TKA.

Number of subjects: Twenty patients (7M and 13F) scheduled for TKA.

Materials/methods: The patients reported to the motion analysis laboratory for gait mechanics evaluation prior to and 3 months post-TKA. The controls were assessed during same time frames, all walking at a self-selected speed. An 8-camera Motion Analysis system (Santa Rosa, CA, USA) and 2 force plates (AMTI, Watertown, MA, USA) were used to record kinematic and kinetic data. Inverse dynamic analysis was performed using OrthoTrak on 5 trials per session on each subject. The dynamic knee joint stiffness, defined as the change in joint moment divided by the change in joint angle, was calculated separately for each trial. The stiffness values of the 5 trials were averaged for each subject and 2-way ANOVA mixed design was used to test for group (between-factor) tained sitting positions. Patient “B” was a 23-year-old female with reported instability and lateral hip and buttock pain. Her symptoms were aggravated by running, walking, stairs, prolonged sitting, sit to stand and rolling in bed. The tester performed movement and alignment tests of the lumbar spine, pelvis and lower extremities. Both patients consistently reported increased symptoms with tests that produced FPGMR. A decrease in symptoms was reported when the tests were repeated with restriction of the observed FPGMR. For example, each patient reported increased pain and instability with the combined motion of hip flexion and medial rotation. When the test was repeated with manual pressure applied to the posterior hip, presumed to prevent posterior glide, each patient reported decreased pain and no feelings of instability. The patients were seen 10 to 12 visits over a 12-week period. Treatment emphasis was placed on education to avoid FPGMR during functional activities. The patients were encouraged to avoid positions of excessive hip flexion, the position where FPGMR was most often observed. Exercises were prescribed to address factors thought to contribute to the movement impairment, such as poor performance of the hip lateral rotators and posterior gluteus medius. Tape was applied to the posterior lateral buttock to restrict hip flexion and provide support to decrease the patients’ pain and feelings of instability.

Outcomes: After treatment, both patients reported decreased symptoms and improved function. Compared to initial assessment, patient “A” reported the following improvements at 12 weeks: decreased pain from 7/10 to 0/10, improved Nonarthritic Hip Score (NAHS) from 74% to 100%, improved Hip Outcome Score (HOS) ADL score from 78% to 99% and improved HOS sports score from 64% to 75%. Patient “B” reported similar improvements at 12 weeks: decreased pain from 8/10 to 0/10, improved NAHS from 71% to 96%, improved HOS ADL score from 73% to 90% and improved HOS sports score from 69% to 88%.

Discussion: We have presented 2 patients with the MSI diagnosis of femoral posterior glide with medial rotation. Diagnosis specific treatment to address the movement impairments resulted in a decrease in the patient’s pain and an improved ability to perform functional and recreational activities.

T2 joint degeneration, as well as males and females.

Results: Decreased leisure-time exercise and increased pain during a MVIC predicted disability for the entire group (R² = 0.23, P = .02). Decreased activity level predicted disability with high radiographic evidence of OA (R² = 0.27, P = .01), while increase in quadriceps activation predicted increase disability in patients with low levels of degeneration (R² = 0.54, P = .02). Increased external knee flexion moment increased disability in females (R² = 0.18, P = .05), while increased pain during both a MVIC and a step-up predicted disability in males (R² = 0.69, P = .001).

Conclusions: These data suggest that factors predicting disability are different depending on radiographic evidence and sex.

Clinical relevance: These data provide evidence that the disability of patients with TFOA may be affected by different factors. Pain with muscle contraction may limit activity level, although alternate motor control strategies may be employed depending on degeneration level and sex. These data may provide further evidence that general physical activity is beneficial to counteract disability in patients with TFOA.

Diagnosis and treatment of 2 patients with hip pain using the movement system impairment classification system

Smith C, Bloom N, Sahrmann SA, Harris-Hayes M
Physical Therapy, Washington University, Saint Louis, MO

Background and purpose: In the treatment of young adult hip pain, a prevailing emphasis has been on mobilization, yet we have identified patients who report feelings of instability associated with their hip pain. Clinical tests often indicate increased posterior hip joint mobility in these patients suggesting a different treatment approach may be needed. We describe the examination, diagnosis and treatment of 2 patients with the Movement System Impairment (MSI) diagnosis of femoral posterior glide with medial rotation (FPGMR).

Case description: Patient “A” was a 26-year-old female with reported instability and left groin, lateral hip and buttock pain. Her symptoms were aggravated by running, walking, elliptical training, and rising from sus-
Patients with knee osteoarthritis utilize a unique muscle co-activation pattern during walking that results in stiff-knee gait, to reduce pain due to the progression of the disease, which becomes habitual over time. Therapists should determine whether or not this pattern persists following TKA surgery and implement retraining protocols to reverse it.

**THE ASSOCIATION BETWEEN HOSPITAL DISCHARGE STATUS AND OUTCOMES FOLLOWING TKA**


**MATERIALS/METHODS:** This retrospective study involved 125 patients who received a TKA. Seventy-three patients were referred to OP and 52 were referred to HH prior to OP. Data collected included demographics (age, gender, body mass index [BMI]), hospital length of stay (LOS), recovery time (days from surgery to discharge from OP), KOOS, 6-minute walk test (6MWT), and ROM. Since pre-op data were available for 87 patients and outpatient data were available for 88 patients, sensitivity analyses were completed to determine if those with missing data had different demographic or clinical characteristics than those with complete data. Chi-square and ANOVA were used to detect between-group associations.

**RESULTS:** There were no differences in the sensitivity analyses between those with and without pre-op data. There were no between group differences in demographics or pre-op KOOS scores. When expressed as a percentage of predicted values, the HH cohort scored lower on the 6MWT than the OP cohort (61.4% versus 69.8%; P = .02). The HH cohort had a longer LOS than the OP cohort; 81% of the HH cohort versus 96% of the OP cohort had a LOS of < 3 days (P = .02). Total recovery time was greater for the HH cohort than for the OP cohort (63.3 versus 49.7 days; P = .001). There were no between-group differences in KOOS or 6MWT at discharge from OP. A sensitivity analysis revealed that patients who did not have data collected at discharge from OP PT had higher knee extension ROM (EXT) at hospital discharge compared to those who had complete data sets. Hence, results of EXT are interpreted judiciously. At hospital discharge, those in HH had better EXT (2.2° versus 3.8° for HH and OP, respectively; P = .002). EXT decreased at the start of OP PT (8.2° and 4.5° for HH and OP, respectively; between-group P = 0.0007). Improvements to 1.3° and 0.5° for HH and OP, respectively, were seen at discharge from PT, with between-group differences statistically significant (P = .04). Knee flexion ROM differed between HH and OP at hospital discharge (89.5° versus 92.2°, respectively; P = .0005), at start of OP PT (97.5° versus 91.9°, respectively; P = .03), and at OP PT discharge (113.6° versus 120.0°, respectively; P = .0003).

**CONCLUSIONS:** Pre-op 6MWT, LOS, and discharge disposition to HH may be related. Despite longer recovery times, outcomes were similar between the OP and HH by the time of discharge from OP PT.

**CLINICAL RELEVANCE:** Patients with impaired functional mobility may need longer hospital stays and HH services. However, similar functional outcomes may be achieved by the end of the recovery period.

**SPEED, RESISTANCE, AND UNEXPECTED ACCELERATIONS DIFFERENTIALLY INFLUENCE KNEE MOVEMENT CONTROL DURING A SINGLE LEG SQUAT**

Shaffer MA, Shields RK

**PURPOSE/HYPOTHESIS:** We recently developed a method to measure the accuracy of performing the single limb squat exercise while concurrently manipulating the resistance, speed of movement, and stability of the device (perturbation). The purpose of this study was to determine if changes in speed, resistance, and acceleration either independently or in combination lead to reduced movement accuracy. The overall goal is to develop a progressive protocol that increasingly challenges the neuromuscular control system. We hypothesized that increases in speed and resistance would show linear changes in movement accuracy, while unexpected perturbations would lead to nonlinear increases in accuracy.

**MATERIALS/METHODS:** Each subject was asked to track a computer generated sinusoidal target as they performed a single limb squat exercise. The target corresponded to ~30° of knee flexion and knee extension. Instantaneous visual feedback of actual knee position was provided to subjects on the same monitor as the target trace. Absolute error was calculated as the absolute difference between the target and actual knee displacement. During each single limb squat bout, the speed of movement (as determined by the target: ~30°/s to 70°/s) and the resistance level (4%, 8%, 12%, and 16% body weight) were randomly changed. Periodically, an unexpected release of the resistance produced a perturbation. Changes in speed, resistance, and the presence or absence of perturbations created a series of 32 test conditions. Repeated Measures Analyses of Variance were used to assess significant changes.

**RESULTS:** Progressive increases in speed resulted in a linear increase in absolute error (1% to 15%; P < .05). Progressive increases in resistance also resulted in increased error (2% to 15%; P < .05), but it covaried with speed and was nonlinear. Likewise, during unexpected perturbations the error was extremely high (>15 cm) when resistance and speed were set at the highest levels (16% body weight, ~70°/s). Indeed, it is clear that tracking a target at high speeds challenges the neuromuscular control system, while tracking may not necessarily become more challenging by simply increasing resistance. Unexpected perturbations are differentially challenging to the nervous system depending on the degree of resistance and speed of the task.

**CONCLUSIONS:** By manipulating the speed, resistance, and unexpected perturbations during a single limb squat, a hierarchical protocol was established to measure changes in neuromuscular control.

**CLINICAL RELEVANCE:** This study provides the groundwork to quantify the level of knee control after injuries such as surgery, stroke, spinal cord injury, or multiple sclerosis. The scale developed in this project shows a hierarchical framework that will enable a clinician to quantify improvement or decline in neuromuscular control of the knee.
To determine if within- and between-session measured with 2 micro strain gauges during 5 distinct clinical measure a custom made testing system. Linear displacement of the middle and MATERIALS/METHODS: All subjects used the OPTIMAL to rate their perceived difficulty and confidence when performing 10 upper extremity functional tasks before and after 1 clinic visit to physical therapy. The OPTIMAL uses a 5-point Likert scale. In addition, subjects also rated their pain levels on a 10-point scale. To assess the responsiveness of the OPTIMAL, 14 subjects completed the instrument at 2 or 4 weeks after the initial visit. The magnitude of the change in scores was determined by using a dependent t test with significance set at (P<.05).
RESULTS: There was no difference in pre and post mean evaluation scores for Difficulty (P = .095) or Pain (P = .061). However, mean Confidence scores improved following the initial physical therapy session (P = .045). The mean Difficulty, Confidence, and Pain scores all increased (P<.05) over the 2 to 4 weeks duration of the physical therapy treatments. Accordingly, the modified OPTIMAL was responsive in all domains (difficulty, confidence, and pain) after 2 to 4 weeks of treatment, but was not responsive to a single physical therapy treatment for 2 domains (difficulty and pain). However, 1 visit caused a significant increase in the patients’ confidence to perform shoulder tasks.
CONCLUSIONS: The OPTIMAL measurement scale appears suitable for measuring both short term (1 session) and long term (2-4 weeks) changes in treatment in out-patients with shoulder impairment.
CLINICAL RELEVANCE: The OPTIMAL is a stable and responsive clinical measurement tool to monitor patients with shoulder impairments. Moreover, the patients’ confidence to perform functional tasks may improve after only 1 visit, suggesting an educational component of the treatment session and the measurement tool capacity.

MEASURING GLENOHUMERAL JOINT POSTERIOR CAPSULE STIFFNESS
Borstad J, Dashottar A, Haas C, Jones G
Physical Therapy Division, Ohio State University, Columbus, OH; School of Allied Medical Professions, Ohio State University, Columbus, OH; Biomedical Engineering, Ohio State University, Columbus, OH; Sports Medicine, Ohio State University, Columbus, OH
PURPOSE/HYPOTHESIS: Increased glenohumeral (GH) joint posterior capsule stiffness is associated with decreased GH internal rotation range of motion, altered GH arthrokinematics, and is believed to be a pathomechanism for both internal and extrinsic impingement of the shoulder. Accurate assessment of GH posterior capsule stiffness can determine if posterior GH capsule stiffness is contributing to shoulder symptoms and if stretching the posterior capsule is indicated. However, it is unknown whether or not current clinical tests used to assess posterior GH capsule stiffness are actually measuring stiffness of the capsule. This project compares clinical measures of posterior GH capsule stiffness under varying capsule conditions.
NUMBER OF SUBJECTS: Fresh cadaver specimens of the scapula and entire upper extremity were examined (n = 4). Mean age of the specimens was 75.5 years.
MATERIALS/METHODS: Specimens were secured in anatomic position on a custom made testing system. Linear displacement of the middle and lower regions of GH posterior shoulder muscle and capsule tissue was measured with 2 micro strain gauges during 5 distinct clinical measure-
**OP02112**

**COMPARISON OF LOWER TRAPEZIUS AND SERRATUS ANTERIOR MUSCLE ACTIVATION DURING SHOULDER FLEXION UNDER 3 HAND-HELD LOAD CONDITIONS IN YOUNG AND OLD ADULTS**

Gloystein J, Sullivan K, Decker AM

Hruska Clinic, Lincoln, NE; Sports Rehabilitation, Overland Park, KS; Physical Therapy, Rockhurst University, Kansas City, MO

**PURPOSE/HYPOTHESIS:** Abnormal scapular kinematics and muscle function significantly contribute to shoulder pain and pathology. An understanding of normal scapular movement and electromyographic (EMG) profiles in asymptomatic individuals will provide healthcare professionals a foundation for evaluation of pathology. The muscles predominantly involved in scapular rotation during forward flexion are the upper trapezius, lower trapezius, levator scapulae, and serratus anterior. The purpose of this study is to evaluate the activity of the serratus anterior and lower trapezius muscles during forward shoulder flexion under various load conditions between 2 groups: young (18-30 years) and old (60-85 years) adults. The hypothesis to be investigated is an increase in load across both groups will elicit an increase in percentage maximal voluntary isometric contraction (MVIC).

**NUMBER OF SUBJECTS:** A total of 55 individuals participated in this study. The young subjects consisted of thirty individuals (15 females, 15 males), while the old subjects included 25 individuals (13 females, 12 males).

**MATERIALS/METHODS:** EMG activity of the serratus anterior and lower trapezius of the dominant arm was measured using surface electrodes during forward flexion of the shoulder. The data were normalized using percentage MVIC. Three different load conditions were evaluated for each group: (1) no load, (2) 2 lb, and (3) 5 lb.

**RESULTS:** There was a significant difference between load conditions across both groups. Each group displayed an increase of MVIC percentage for serratus anterior and lower trapezius as load increased. In addition, the serratus anterior muscle activity results revealed a significant interaction between individuals that exercise versus individuals that do not exercise on a regular basis. When examining the older adult population, lower trapezius muscle activity was significantly greater when compared to the younger population.

**CONCLUSIONS:** In order to maintain normal kinematics, the scapula and humerus must maintain a relationship which is significantly influenced by the serratus anterior and lower trapezius. Both muscles displayed greater recruitment during shoulder flexion when lifting increasing distal loads.

**CLINICAL RELEVANCE:** The findings of this study can easily be applied to clinical practice. In order to generate greater muscle activation of these muscles, it is essential to increase the distal load as the patient progresses through the rehabilitation process. In addition, older adults may require greater emphasis on the lower trapezius when designing shoulder strengthening programs.

**OP02113**

**A FUNCTIONAL CLASSIFICATION SYSTEM FOR INDIVIDUALS WITH SUBACROMIAL IMPINGEMENT SYNDROME UTILIZING THE PSS AND DASH: A RETROSPECTIVE ANALYSIS**

Kasimir M, Sugden J, Smith A, Thigpen CA

Physical Therapy, University of North Florida, Jacksonville, FL; Proaxis Therapy, Greenville, SC

**PURPOSE/HYPOTHESIS:** Health-related quality of life and patient-specific function are important components of physical therapists’ thinking about disease and injury. Functional classification systems can be used to determine interventions that are successful at improving function and quality of life. The purpose of this study is to explore functional classifications utilizing the PSS and DASH in subjects with SAIS. This study will investigate whether the questions within the PSS and DASH can be separated into 2 groups to represent disorders related to a lack of stability or a lack of mobility of the shoulder. The researchers hypothesize that it is possible to group the questions of the PSS and DASH to create functional classification categories.

**NUMBER OF SUBJECTS:** 60.

**MATERIALS/METHODS:** A retrospective analysis was conducted from data obtained from an ongoing clinical study examining subjects with SAIS. Two investigators reviewed the PSS and DASH questions to develop groups of questions that described similar functional tasks. The purpose of grouping questions was to create 2 separate and unique functional categories within subjects were placed, based on the nature of their functional loss. These 2 categories include a mobility group (function related to a lack of mobility) and a stability group (function related to a lack of stability). Data analysis was performed to separate the subjects into 1 of the 2 groups for both the PSS and DASH. Impairments for all subjects in each category were then grouped together and analyzed separately. Each investigator analyzed the data separately to investigate trends to determine whether subject impairments correlated with the subgroup the subjects were placed in.

**RESULTS:** Viewing each measurement tool independently, several correlations between the impairments demonstrated by the subjects and their respective classification were noted. The PSS and DASH mobility and stability groups were successful at differentiating between a problem with a lack of stability or a lack of mobility for 3 of the 7 impairments measured: ROM, muscle strength, and scapular dyskinesis, while the remaining 4 impairments were not successful at accomplishing this task.

**CONCLUSIONS:** With the adoption of the ICF model, methods of measuring and assessing function are needed. Analysis of possible relationships between groupings and impairments of subjects with SAIS revealed that responses to certain questions from the PSS and DASH may be divided into 2 separate groups to measure functional loss related to an underlying lack of mobility or a lack of stability at the shoulder in individuals with SAIS. ROM, muscle strength, and scapular dyskinesis most strongly corresponded with the PSS and DASH mobility and stability groups.

**CLINICAL RELEVANCE:** SAIS can present with a wide variety of impairments and functional losses. Categorizing those with SAIS into more homogeneous, functional categories may help clinicians in designing patient specific interventions utilizing the ICF model framework.

**OP02114**

**A CADAVERIC STUDY USING THE NAIOMT TECHNIQUE FOR ASSESSMENT OF THE GLENOHUMERAL LIGAMENTS**

Millar A, Kissler S, Sharpe A, Banks J

Physical Therapy, Andrews University, Berrien Springs, MI

**PURPOSE/HYPOTHESIS:** Ligamentous tests are an important component of a complete orthopedic assessment. Tests for the shoulder ligaments have often been limited to stability tests, however, the North American Institute of Manual Therapy (NAIOMT) suggests test positions to specifically stress each component of the glenohumeral ligaments. Thus, the purpose of this study was to determine which positions placed the maximal amount of tension on the superior, middle and inferior glenohumeral ligaments. It was hypothesized that the NAIOMT recommended position would place the ligament at its greatest length.

**NUMBER OF SUBJECTS:** Nine cadavers, ages 71 to 96 years old were included in the sample.

**MATERIALS/METHODS:** The humerus and scapula were detached from each of the cadavers and excess tissue was removed. To access the glenohumeral ligaments, an incision was made through the posterior capsule. Steel straight pins were placed in both ends of the superior, mid-
dle and inferior glenohumeral ligaments. The distance between pins was measured using a digital mechanical caliper (accurate to 0.1 mm). Following measurement of the ligament in a resting position (no tension), each ligament was tested in 3 other positions. All were at end range external rotation (ER), along with specific positions of abduction and extension. Length was measure in each position, with the greatest length believed to represent the greatest tension. A 1-way repeated measures ANOVA and paired t tests were used to compare measures between the different positions for each ligament. Differences were considered significant if at the .05 level of probability.

RESULTS: A total of 17 shoulders had viable glenohumeral ligaments, with fewer for selected components. As hypothesized, each ligament was at its greatest length in the recommended position. The superior ligament was at its greatest average length (M = 33.5 mm) in ER, 0° abduction with an anterior glide. The middle ligament had an average maximal length of 29.5 mm when in ER, 45° abduction and 10° extension, with an anterior-or-medial glide. The inferior ligament was at its greatest average length (M = 30.8 mm) in ER, 90° abduction, 10° extension, with an anterior-medial glide. Differences between the NAIOMT recommended and other positions was statistically significant.

CONCLUSIONS: The NAIOMT recommended glenohumeral test positions appear to put each ligament in a position which would provide the greatest stress to the ligament. Such test positions might provide more specific information regarding ligamentous damage or instability. Extrapolation to patient populations is limited due to the nature and age of the sample, thus further studies with patient populations are recommended.

CLINICAL RELEVANCE: Clinical tests of shoulder instability are limited, in that they generally test all of the ligaments together. Tests that allow clinicians to identify which component of the glenohumeral ligament is involved might allow a more specific treatment approach.

**OP20115**

**EFFECTS OF ELEVATION ANGLE AND PLANE OF MOTION ON SUBACROMIAL AND INTERNAL IMPINGEMENT**

Petersen BW, Nygstrom CS, Pham TD, Hybben NM, Camargo PR, Phadke V, Bramer JP, LaPrade RF, Ludewig PM

Physical Therapy, University of Minnesota-Twin Cities, Minneapolis, MN; Orthopaedic Surgery, University of Minnesota-Twin Cities, Minneapolis, MN

PURPOSE/HYPOTHESIS: Shoulder impingement is thought to be the compression of soft tissues beneath the coracoacromial arch or with the glenoid-labral complex as the arm is raised overhead. Our purpose was to quantify the available 3-D subacromial volume and minimal distance to potential impinging structures during active scapular plane abduction, flexion, and abduction at progressive angles of elevation.

NUMBER OF SUBJECTS: Nineteen subjects (11 asymptomatic, 8 symptomatic; 9 males; right shoulder tested in 9 subjects).

MATERIALS/METHODS: Kinematic data were collected using electromagnetic motion tracking. CT scans were reconstructed into 3-D models of the shoulder and subacromial volumes (anterior, middle, and overall). Models were rotated based on kinematic data to calculate subacromial volumes and minimal distances at rest, 30°, 60°, 90°, and 120° during scapular plane abduction, flexion and abduction. Remaining subacromial volumes were expressed as a percentage of each subject’s initial rest volumes. Three-way ANOVAs were calculated for the effects of motion and angle across groups.

RESULTS: Overall and middle volumes were significantly decreased (~8%-10%) at 90° humeral elevation for asymptomatic subjects. The middle volume was significantly reduced in abduction versus flexion in both groups (~6%). The anterior volume was significantly reduced in symptomatic subjects in abduction versus asymptomatic subjects (~9%) and at 90° of abduction across both groups (~3%). The supraspinatus insertion was significantly closer to the acromion at 60° versus 30° and 90° for abduction and scapular plane abduction. The linear distance between the glenoid and the infraspinatus insertion, as well as the posterior insertion point of the supraspinatus tendon, was significantly less for the symptomatic group versus the asymptomatic group at 90° and 120° of humerothoracic elevation (~4-5 mm).

CONCLUSIONS: For asymptomatic subjects, the middle and overall volumes were most reduced at 90° of elevation; however, the lateral edge of the greater tuberosity came closest to the undersurface of the acromion at 90°. The supraspinatus insertion was in closest proximity to the acromial undersurface at 60° of elevation, and closer to the glenoid at 120° of elevation and above. Proximity to the glenoid reflects internal rather than subacromial impingement.

CLINICAL RELEVANCE: Patients with a painful arc of motion above 90° are likely experiencing internal rather than subacromial impingement. The symptomatic group appeared to present with more internal rather than subacromial impingement. In addition, their greater anterior subacromial volume reductions during arm abduction suggest possible anterior translation of the humeral head, or coracoacromial ligament impingement. Patients presenting with subacromial impingement may be advised to avoid elevation into abduction as compared to flexion. Clinicians should consider the complex changes in subacromial volume across motions and angles when planning shoulder interventions.

**OP20116**

**APPLICATION OF A REGIONAL INTERDEPENDENCE MODEL IN THE RESOLUTION OF CHRONIC SHOULDER PAIN IN A THROWING ATHLETE**

Rodic B, Peers BS, Lehr M

CPRS Physical Therapy, Millersburg, PA; Lebanon Valley College, Annville, PA

BACKGROUND AND PURPOSE: The purpose of this case report is to describe the use of a regional interdependence model and functional movement screening to address chronic shoulder pain in a throwing athlete. The concept of regional interdependence can be applied by classifying patients into subgroups. Once a clinician appropriately classifies a patient, then a specific category of intervention can be implemented to address the patient’s specific need and goals. Outcome measures are growing in popularity, and have become a necessity in today’s health care environment.

CASE DESCRIPTION: A 53-year-old right hand dominant baseball coach who reported chronic right anterior and inferior shoulder pain exacerbated following an increase number of pitches thrown. Clinical findings included: pain 7/10 anterior/inferior shoulder pain with throwing; Quick DASH 36/0; QuickDASH Sports Module 88/0. Body structures/functions were identified as follows: mobility impairments of posterior shoulder capsule, glenohumeral internal rotation deficit (GIRD), and thoracic spine hypomobility at levels T1-T5. Primary stability impairments included moderate strength deficits of the lower trapezius and rhomboid musculature, and poor neuromuscular control of the scapula during right upper extremity movement. Functional movement screening was performed and identified moderate core stability deficits primarily in the transverse plane. In addition, standing multisegmental right rotation was identified to be the most significant asymmetrical movement pattern followed by the deep squat secondary to bilateral hip internal rotation mobility restrictions. Plan of care included a systematic progression of interventions that emphasized manual and neuromuscular/functional exercise techniques based on the following PT diagnoses: (1) posterior shoulder, thoracic extension and right rotation deficits, (2) scapular and core stability deficit. A clinical reasoning model referred to as the Treatment Options Grid (TOG) was utilized to encourage patient centered goal achievement respective to throwing.

OUTCOMES: Patient was seen for a total of 10 visits over 7 weeks with 0/10 pain with overhead and throwing activities and improved subjective pitching velocity and accuracy. Quick DASH and Quick DASH Sports Module improved to 0/0.

DISCUSSION: Currently, there is limited literature focusing on regional in-
terdependence and how it may impact upper quarter functional limitations. In addition, clinical interventions that emphasize manual and neuromuscular implications allow the clinician to effectively and efficiently address the specific biomechanical and sports specific needs of the overhead throwing athlete. In this case, the use of a regional interdependence model and a functional movement screen provided a framework for the identification of movement impairments, biomechanical faults, stability and mobility deficits. This approach, when applied to an overhead athlete, illuminated several key impairments they may have otherwise have not been identified.

**OP02117**

**THE PSYCHOMETRIC PROPERTIES OF THE CONSTANT-MURLEY SCORE: A SYSTEMATIC REVIEW**

Roy JS, MacDermid JC, Woodhouse LJ

School of Rehabilitation Sciences, McMaster University, Hamilton, ON, Canada

**PURPOSE/HYPOTHESIS:** It has been suggested that the Constant-Murley score (CMS) is the most appropriate shoulder function score since it includes both self-report and performance-based components. However, others have questioned this scale based on concerns with standardization, reliability across testers and validity for specific purposes. It is important to systematically evaluate the quality and content of the research studies that assessed the measurement properties of the CMS to fully understand its utility. The purpose of this study was to conduct a systematic review of the psychometric evidence relating to Constant-Murley score.

**NUMBER OF SUBJECTS:** A total of 42 articles were reviewed. Thirty-five met all inclusion criteria and were included for full review.

**MATERIALS/METHODS:** Using 3 databases (Medline, CINAHL, Embase), a structured search was conducted. In total, 35 published primary studies were analyzed. Pairs of raters used structured tools to perform critical appraisal and data extraction. A descriptive synthesis was performed.

**RESULTS:** Quality ratings of 23% of the studies reviewed reached a level of 75% or higher. Studies evaluating the content validity of the CMS suggest that the description in the original publication is insufficient to accomplish standardization between centers/evaluators. Despite this limitation, the CMS correlates strongly \( r(>0.70) \) with shoulder-specific questionnaires, reaches acceptable benchmarks \( (\rho>0.80) \) for its reliability coefficients, and is responsive \( (\text{effect sizes and standardized response mean}>0.80) \) for detecting improvement following intervention in a variety of shoulder pathologies.

**CONCLUSIONS:** This systematic review provides evidence to support the use of the CMS for specific clinical and research applications, but underscores the need for greater standardization and precaution when interpreting scores. Despite identifying 34 studies that address at least 1 psychometric property of the CMS, a number of issues remain unresolved. Methods to improve standardization and measurement precision are needed. While responsiveness has been shown to be excellent, some properties still need to be evaluated, particularly those related to the absolute errors of measurement and minimal clinically important difference. Our review also raises concerns about the quality of existing studies as only 23% reached a quality level of more than 75%.

**CLINICAL RELEVANCE:** Clinicians using the original version of the CMS must be aware that major psychometric properties, such as content validity, minimal detectable change and minimal clinically important difference, have not been demonstrated. Given the widespread acceptance for usage of the CMS in clinical studies and early indications that the measure is responsive, studies defining more rigid standardization of the tools/procedures are needed.

**OP02119**

**EVALUATION AND TREATMENT OF A PATIENT AFTER ROTATOR CUFF REPAIR USING THE MOVEMENT SYSTEMS IMPAIRMENT MODEL**

Stanley E

Arizona OrthoSports Physical Therapy, Glendale, AZ

**BACKGROUND AND PURPOSE:** While it is important to address range of motion (ROM) and functional deficits when treating postsurgical orthopedic patients, it is equally important to address movement impairments that also contribute to limitation, to provide complete care. In order to address these impairments, thorough and systematic evaluation and treatment, such as the Movement Systems Impairment (MSI) model, must be utilized. The purpose of this case study is to describe the importance of MSI to evaluate and treat a patient after rotator cuff repair.

**CASE DESCRIPTION:** The patient was a 44-year-old male who underwent left rotator cuff repair 10 weeks prior to evaluation. The patient received prior postsurgical treatment, consisting of glenohumeral ROM and strengthening exercises. The patient’s chief complaints included decreased active ROM bilaterally and pain in the right upper trapezius. The patient was unable to work, as the patient’s job requirements in-
CONCLUSIONS:

trarater reliability for 2 of the examiners (P > 0.05), an reliability ranged from low to moderate. Further studies are needed to confirm these findings.

OPO2121

AN EMG COMPARISON OF SERRATUS ANTERIOR MUSCLE ACTIVITY DURING A TRADITIONAL MUSCLE TESTING POSITION AND A NOVEL MUSCLE TESTING POSITION

Talbott N, Witt D

Rehabilitation Sciences, University of Cincinnati, Cincinnati, OH

PURPOSE/HYPOTHESIS: Manual muscle testing (MMT) of the serratus anterior (SA) muscle is a common assessment technique employed by physical therapists in clinical practice. Previous studies have utilized EMG analysis to investigate the ability of various muscle testing positions to elicit and isolate the activity of the SA. It is not clear from previous studies that if mean muscle activity is not the primary concern, that the SL position results in significantly less concurrent EMG muscle activity in both the upper and lower trapezius muscles as compared to the TS position. While a significant difference was not found between the 2 positions for the middle trapezius, a trend toward less EMG muscle activity in the SL position for the middle trapezius was exhibited.

CONCLUSIONS: Our data indicates that the TS position for MMT of the SA produces significantly greater mean SA muscle activity as compared to the SL position, but does not confer a significant advantage over the novel SL position in regards to the elicitation of peak EMG SA muscle activity. On the other hand, the novel SL position in comparison to the TS position results in significantly less concurrent EMG muscle activity in both the upper and lower trapezius musculature, which suggests the SL position, may be more advantageous if isolating SA activity is the desired goal.

CLINICAL RELEVANCE: Clinicians must exercise caution when basing intervention selection for the GH joint solely on inferior glide accessory motion assessment. Scapular stabilization would not improve the clinician’s ability to reliably assess GH inferior glide.

OPO2122

OUTCOMES OF STANDARDIZED EXERCISE AND MANUAL THERAPY FOR SUBACROMIAL IMPINGEMENT SYNDROME: A CASE SERIES

McClure P, Tate AR, Michener L, Seats AL, Thigpen CA, Young I, Salvatori R

Physical Therapy, Arcadia University, Glenside, PA; Physical Therapy, Virginia Commonwealth University, Richmond, VA; Prowaix Therapy, Greenville, SC; Savannah Spine and Sport, Savannah, GA

CONCLUSIONS: The results of this pilot study suggest that scapular stabilization does not improve interrater or intrarater reliability for assessment of an inferior glide at the GH joint.
C O M B I N E D  S E C T I O N S  M E E T I N G

PURPOSE/HYPOTHESIS: The purpose of this case series is to describe a standardized treatment program for subacromial impingement (SAIS) and to report the outcomes at patient discharge and 3 month follow up using validated measures of both impairment and function.

NUMBER OF SUBJECTS: Ten patients (5 females; mean age, 45 years; range, 19-70).

MATERIALS/METHODS: All patients met inclusion and exclusion criteria and were treated with a standardized program of strengthening, stretching, manual therapy, and a home exercise program for 10 visits over 6 to 8 weeks. The protocol included a 3-phase progressive strengthening program (phase 1: shoulder ER and IR with the arm at side, protrac- tion, cervical and scapular retraction, and active elevation with upper trapezius relaxation; phase 2: shoulder elevation, IR and ER with the arm elevated, prone middle and lower trapezius and quadruped serratus exercise; phase 3: phase 2 plus functional and endurance exercises), stretching (thoracic extension over a towel, cross-body adduction, door- way pectorals, shoulder IR and ER rotation and flexion), manual therapy (thoracic spine mobilization and manipulation, glenohumeral pos- terior and inferior glide and manual stretch), and a daily home exercise program of stretching and strengthening. All patients completed a history and measure- ment of impairments and functional disability (DASH) at 2, 4, 6, and 12 weeks. Treatment success was defined as both a 50% or improved DASH score, and a global rating of change of at least “moderately better.”

RESULTS: At 6 weeks, 6/10 patients were successful (DASH initial: 33.9 [16.2], 6 weeks: 8.06 [5.2]) and 4 patients were nonsuccessful (DASH initial: 34.3 [5.5], 6 weeks: 23.5 [8.8]). At 12 weeks, 8 patients were considered successful with the standardized treatment (DASH initial: 33.1 [14], 12 weeks: 8.3 [6.4]), and 2 patients were nonsuccessful (DASH initial: 37.8 [2.8]; 12 weeks: 27.1 [1.1]). As a group, the largest improve- ment was in the first 2 weeks. Patients successful at 6 weeks improved in a roughly linear fashion and maintained that improvement between 6 to 12 weeks, 2 patients plateaued between 2 to 4 weeks and progressed linearly early through 12 weeks. Two patients considered failures did not progress significantly after 2 weeks. The most common impairments for all 10 patients were cuff and trapezius weakness (10/10), decreased internal rotation (8/10), and midthoracic flattening (7/10).

CONCLUSIONS: A program aimed at strengthening rotator cuff and scapular muscles, with stretching and manual therapy aimed at the posterior/ inferior capsule and thoracic spine was successful in the majority of pa- tients. The time-course of improvement was documented over 12 weeks using validated measures of impairment and outcome.

CLINICAL RELEVANCE: Few standards exist to define appropriate SAIS reha- bilitation for both specific exercises or dosage and manual therapy. The expected time-course for improvement is also not well documented. This series documents a standardized treatment and suggests that 6 weeks may be sufficient time for many patients but some may require addition- al time for symptomatic and functional improvement.

OP02124
QUANTITATIVE STRENGTH MEASUREMENTS FOR SCAPULAR PROTRACITION AND RETRACTION

Williams DA

Physical Therapy, East Tennessee State University, Johnson City, TN

PURPOSE: To review quantitative methods for measuring scapular protraction and retraction strength in the clinic and propose an algorithm for choosing a method of measurement.

DESCRIPTION: A review was made of quantitative methods for measuring scapular protraction and retraction strength in the clinic, the popula- tion studied, and the outcome measurements. Since 1990 there have been at least 9 reports of measuring maximal isometric scapular protraction and retraction strength using hand-held dynamometers. Like- wise, since 1993 there have been at least 5 reports of measuring concentric isokinetic scapular protraction and retraction strength. Both methods have been found to be reliable, but with numerous variations of the protocols, such as: positioning of the body, shoulder girdle, and upper extremity: stabilization; contact of force transducer; warm-up; familiari- ty sessions; test repetitions and duration; rest intervals; substitution pre- cautions; and outcome measures. Eight reports for measuring maximal isometric force were on young healthy subjects, 2 of which were on base- ball players. There was one report on patients. Overall, the mean forces for protraction and retraction ranged from 13.9 to 52.7 kg and from 5.84 to 38.46 kg respectively. There was a trend of protraction generally being stronger than retraction. The protraction-retraction strength ratio varied from 1.37 to 0.623, it generally being lower with pathology.

OP02123
SHOULDER INSTABILITY: FUNCTIONAL OUTCOMES AND DIFFERENCES IN PRE-SURGICAL REHABILITATION PROGRAMS FOR PATIENTS WHO DO AND DO NOT GO ON TO SURGICAL INTERVENTION

Uhl TL, Fritz JM

Rehabilitation Sciences, University of Kentucky, Lexington, KY; Physical Therapy, University of Utah, Salt Lake, UT

PURPOSE/HYPOTHESIS: Redislocation rates is often the primary outcome variable of interest when treating traumatic shoulder instability, however reduction in pain and disability may be just as important to the patient. The purpose of this study was to determine if changes in function and pain scores are different in patients treated with shoulder instability that ultimately required surgical intervention from those who do not.

NUMBER OF SUBJECTS: Two groups of patients were identified retrospectively from a central database between January 2004 to April 2007, diag- nosed to have uni- or multi-directional shoulder instability from a traumatic (87.7%) or recurring mechanism. Fifty-seven cases (68.4% male; age, 27 ± 13 years) were identified with 10/57 (17.5%) going on to surgi- cal intervention, while the remaining 47/57 (82.5%) were identified as nonsurgical as they did not proceed to surgery following therapy.

MATERIALS/METHODS: All patients completed the Disability of the Arm, Shoulder, and Hand (DASH) and Numeric Pain Rating Scale (NPRS) at baseline and discharge. All charts were reviewed to categorize the type of intervention performed during physical therapy to describe a typical in- tervention for patients with shoulder instability. Interventions were iden- tified as resistive, mobility, home exercise program, and modalities cat- egories. The number of each intervention at each visit was counted and represented as a percentage of the total number of interventions. ANO- VA tests were used to compare the 2 groups for all dependent variables; initial, discharge, and percent change DASH, NPRS scores, age, number of visits, and type of intervention.

RESULTS: No significant difference was found between groups at baseline for DASH (31 ± 21, P = .77) or NPRS (3.6 ± 2.7, P = .43). At discharge, overall improvement was observed but no difference between groups for DASH (15 ± 20, P = .22) or NPRS (1.7 ± 2.3, P = .25). The age of patients (27 ± 13, P = .83) and number of visits (6 ± 3, P = .52) between groups was not different. Although not significant, a trend was noted in those patients going on to surgery had a lower percent change in pain (38 ± 36%) than those nonsurgical patients (60% ± 44%, P = .16) and a higher percentage of their interventions utilized modalities (19% ± 16% versus 10% ± 9%, P = .07). The remaining interventions were not different between groups and consisted of (57% ± 21%) resistive, (17% ± 11%) mo- modality, and (25% ± 24%) home exercise interventions.

CONCLUSIONS: These results support the use of physical therapy follow- ing traumatic or recurrent episodes of shoulder instability to reduce pain and upper extremity disabilities that emphasize resistive and home exer- cise approach. The retrospective approach allows for interventions sub- sequent to physical therapy to be evaluated.

CLINICAL RELEVANCE: The 83% of patients that did not go onto surgery supports a conservative approach to this population but is contrary to previ- ous reports favoring surgical intervention and suggest more research is needed to substantiate these findings.
COMBINED SECTIONS MEETING

Normalization of force data was infrequent. Three reports for concentric isokinetic testing were done at various velocities on young healthy subjects, while one of these reports compared measures of healthy young gymnasts to a healthy nonathletic group. Two reports were done on overhead athletes with impingement, while one of these studies had a control group of healthy overhead athletes. One study provided actual force measurements at 2 velocities with a mean force of 32 kg for protraction at the slower velocity and mean force of 21.47 kg at the faster velocity. For retraction, the mean force was 29.83 kg for the slower velocity and 22.45 for the faster velocity. Some studies used normalization methods to report outcome data. The protraction-retraction strength ratios across all reports ranged from 1.18 to 0.88, with it generally being lower with pathology, high velocity tests, or being a nonathlete.

SUMMARY OF USE: An algorithm of tiered standardized protocols is suggested in order to promote quantitative measurements of scapular protraction and retraction strength in the clinic and be able to make comparisons of future populations to be tested.

IMPORTANCE TO MEMBERS: Advantages and disadvantages of various quantitative measures for scapular protraction and retraction strength in the clinic are reviewed. In addition, a proposed algorithm is introduced to aid members in choosing an appropriate testing method.

COMPARISON OF MUSCLE ACTIVATION PATTERNS DURING THE STANDARD PUSH-UP VERSUS THE PERFECT PUSHUP HANDGRIPS
Program in Physical Therapy, Mayo Clinic, Rochester, MN

PURPOSE/HYPOTHESIS: Manufacturers of the Perfect Pushup grips claim enhanced muscular recruitment when compared to the standard push-up exercise. This study examined muscle activation of the triceps brachii (TB), pectoralis major (PM), serratus anterior (SA), and posterior deltoid (PD) during push-ups performed from 3 different hand positions: (1) shoulder width (SW), (2) wide base (WB), and (3) narrow base (NB). Push-ups were performed under 2 conditions: (1) standard push-up and (2) Perfect Pushup grips. We hypothesized (1) hand position would have a significant effect on muscle activation and (2) Perfect Pushup grips would significantly increase electromyographic (EMG) recruitment of all 4 muscles when compared to standard push-ups.

NUMBER OF SUBJECTS: Twenty healthy subjects (men 24.9 ± 2.6 years) and 9 women (23.8 ± 1 years) volunteered to participate.

MATERIALS/METHODS: Raw EMG signals from the right side were collected with D-100 bipolar surface electrodes at a sampling frequency of 1000 Hz. Maximal voluntary isometric contraction (MVIC) of each muscle was performed using standard manual muscle test procedures. Subjects completed 3 consecutive push-ups for each hand position under both conditions. Push-up speed was controlled using a metronome, and testing order was randomized. EMG signals were normalized to each muscle’s respective peak activity in the MVIC trial and expressed as a percentage. EMG data were analyzed with 3 (hand position) by 2 (condition) repeated-measures ANOVA with a post hoc Bonferroni-adjusted simple effects test to analyze significant position effects for position by condition interactions (α = .05).

RESULTS: EMG activity for the TB was significantly different between hand positions [NB (105%)>SW (93%)>WB (73%)] but not between push-up conditions. For the PM there was no difference in EMG activity between hand position and push-up condition (SW, 101%; WB, 100%; and NB, 102%). For the SA there was a significant hand position effect (P = .002) and position by condition interaction (P = .012). For the standard push-up, SW (86%) and WB (85%) positions revealed greater EMG activation than the NB (68%) position, whereas for Perfect Pushup grips the WB position (87%) was greater than the SW (67%) position. For the SW position the standard push-up condition (86%) had greater activity than Perfect Pushup grips (66%). Both position (P = .003) and condition (P = .002) effects were detected for the PD. Greatest activation of PD was observed in the NB (18%) position than in either SW or WB (13%) positions. Greater activation of the PD occurred in the standard push-up (18%) than with the Perfect Pushup grips (13%).

CONCLUSIONS: A push-up requires considerable muscle activation of the TB, PM, and SA whether performed using standard hand-on-floor position or a new device. The NB hand position is most effective for preferentially activating the TB muscle.

CLINICAL RELEVANCE: Based upon EMG activation from 4 muscles, the Perfect Pushup handgrips do not appear to enhance muscular recruitment when compared to the conventional push-up method.

CLINICAL EXAMINATION AND PRESENTATION OF ADULT ONSET TETHERED CORD SYNDROME IN THE OUTPATIENT PHYSICAL THERAPY CLINIC. A CASE REPORT
Lee MJ
Kentucky Orthopedic Rehab Team, Nicholasville, KY

BACKGROUND AND PURPOSE: Adult Tethered Cord Syndrome (TCS) is a sub classification of spina bifida occulta and describes a congenital condition with a combination of bowel, bladder and musculoskeletal symptoms. Usually identified in childhood, adult onset is rare. There is a 3- to 8-year delay between symptom onset and diagnosis. Patients with adult TCS commonly present with sensori-motor symptoms that may mock common musculoskeletal conditions treated in outpatient physical therapy. Clinical examination must differentiate between a musculoskeletal versus medical condition mocking a musculoskeletal presentation. The purpose of this case report is to describe the clinical examination, presentation and imaging findings of a patient with adult onset TCS self referred to an outpatient physical therapy clinic.

CASE DESCRIPTION: The patient was a self referred 35-year-old female complaining of progressively worsening right leg weakness of insidious onset. She reported tripping and gait difficulties over the past twelve months. Medical history revealed a lifetime history of constipation managed by medication and a recent urgency to urinate. A slightly discolored birthmark was present to the left of L3 and invaginated toward the midline. Dermatomal sensation was normal. Lower extremity strength was globally weaker on the right with inability to heel or toe walk. Deep tendon reflexes were hyper-reflexive bilaterally. Six beat clonus was elicited bilaterally with Babinski and Hoffman’s signs negative.

OUTCOMES: The patient was immediately referred to a primary care physician. Diagnostic imaging revealed spina bifida occulta at L3 with a tethered conus medullaris at L4. She was referred to a neurosurgeon.

DISCUSSION: This is the first case report of adult tethered cord syndrome presenting to an outpatient physical therapist. Clinical findings of reported tripping, bowel and bladder irregularities, lumbar birthmark and neurological examination suggested the possibility of an upper motor neurological condition requiring medical referral. Self referral to physical therapy is increasingly common and consistent with the APTA’s Vision 2020. Leg weakness is a reasonable complaint that would initiate a referral to physical therapy for advice and treatment. Routine examination screening identified a patient requiring referral to a physician. The medical condition was confirmed by diagnostic imaging as adult onset TCS.

RELIABILITY AND VALIDITY OF CLINICAL OBSERVATION OF LUMBOPEVIC RHYTHM
Biely SA, Smith S, Haddad A, Sifflies S
PT and Rehabilitation Sciences, Drexel University, Philadelphia, PA

PURPOSE/HYPOTHESIS: Clinical observation of trunk movement has long been a standard part of the physical therapy examination for patients with mechanical low back pain (MLBP) and has been used to identify aberrant trunk movement patterns including changes in lumbopevic
rhythm (LPR). These aberrant movement patterns have been associated with MLBP in patients who benefit from a program of stabilization exercises. However, reliability and validity of clinical observations of trunk movement has yet to be determined. The purpose of this study is 1) to investigate interrater reliability of both clinical observation and computerized kinematic analysis of LPR and 2) to determine the agreement between these 2 methods.

**NUMBER OF SUBJECTS:** Fifty-two subjects (12 men, 40 women; mean age 45 ± 9) were recruited from an out-patient physical therapy clinic. Subjects included individuals with current MLBP, previous episode of MLBP, and no history of MLBP.

**MATERIALS/METHODS:** The 3Space Fastrak was used to collect kinematic data. Sensors were placed on the femur, sacrum, lumbar, and thoracic spine. Each subject performed 3 repetitions of forward bending and return to upright. During kinematic data collection, 2 experienced clinicians blinded to subject group, simultaneously observed the LPR. Clinicians recorded whether the LPR was typical or aberrant for each movement trial. The kinematic data were processed to create angle-angle plots of pelvis or hip versus lumbar spine movement. The individual angle-angle plots depict the coordination between the segments. The plots were rated as either typical or aberrant by 2 blinded raters. Kappa statistics were used to determine interrater reliability of both clinical observations and rating of kinematic angle-angle plots. Kappa statistics were also used to determine agreement between the clinical observations and kinematic data plots.

**RESULTS:** Interrater reliability of rating lumbopelvic rhythm as typical or aberrant for each trial through clinical observation was excellent (95% agreement, kappa = .85). Interrater reliability of rating kinematic angle-angle plots as typical or aberrant was substantial (agreement 83%, kappa = .65). The agreement between clinical observation (30 aberrant trials) and kinematic angle-angle plots (50 aberrant trials) was fair (agreement 75%, kappa = .37).

**CONCLUSIONS:** These findings indicate that clinical observation of trunk movement patterns is a reliable method of identifying aberrant LPR. The fact that kinematic analysis identified a greater number of aberrant LPR patterns may indicate that a certain threshold of aberrant movement must be reached before it can be detected by the clinician. This may have contributed to the less than moderate agreement between clinical observation and kinematic analysis.

**CLINICAL RELEVANCE:** This study indicates that aberrant LPR patterns can be reliably observed and measured. Furthermore, the agreement between clinical observation and kinematic analysis helps to support the validity of clinical observation.

**OP02128**

**ASSOCIATION AMONG MEASURES OF PAIN EXPERIENCE AND MUSCLE DAMAGE IN ACUTE ONSET LOW BACK PAIN**

**Bishop MD, Horn ME, Lott DJ**

University of Florida, Gainesville, FL

**PURPOSE/HYPOTHESIS:** Clinical literature suggests that there is a weak relationship between pathoanatomy and self report of pain intensity in patients with low back pain (LBP). The purpose of this research was to further examine this relationship in an acute pain model using exercise-induced delayed onset muscle pain.

**NUMBER OF SUBJECTS:** 12 volunteers (21.1 ± 1.7 years; 5 female) read and signed a consent form approved by the local IRB.

**MATERIALS/METHODS:** Subjects completed an examination including self-report pain questionnaires (100 mm visual analogue scale [VAS] and a body pain drawing diagram indicating the area), a psychological measure known to be associated with pain intensity (Fear of Pain Questionnaire) and the Physical Impairment Index (PII). Mechanical pressure pain threshold was measured in the lumbar paraspinals. T1 and T2 weighted magnetic resonance imaging (MRI) provided transaxial images of the lumbar paraspinal muscles from L3 through S1. All measures were collected at baseline and 48 hours after an exercise regimen used to induce delayed onset muscle soreness (DOMS) in the lumbar extensors. Signal intensity was calculated from regions of interest at the intervertebral levels in both the lumbar multifidus and erector spinae muscles for determining mean T2 values, and percentage change in T2 was calculated for each muscle group. Percentage change values for T2 signal intensity were summed to give a single value at each intervertebral level. Wilcoxon signed rank tests compared the percent change in T2 between the multifidus and erector spinae, the change in the total percent change in T2 between spinal levels, and mechanical hyperalgesia before pre- and postexercise. Bivariate associations were calculated using a Pearson correlation moment among percent change in T2 at L3 and L5, pain intensity, drawing area of pain, PII, muscle fatigue during the DOMS protocol and fear.

**RESULTS:** Median pain intensity at 48 hours was 23 mm (range, 0–49 mm). Greater percent change in T2 was noted in the multifidus than the erector spinae (P = .05). Also, there was a trend for the change in signal intensity to be greatest at L3-L4 (P = .06). Mechanical hyperalgesia was confirmed by a statistically lower threshold at 48 hours (P = .009). No statistically reliable associations were noted among reported variables except for a moderate correlation between T2 intensity change at L3-L4 and drawing area of pain (r = .66, P = .03).

**CONCLUSIONS:** These data suggest that the association between reported pain intensity and muscle damage is tenuous in subjects experiencing experimentally induced acute LBP. This finding supports the clinical data indicating a weak to no association between pathoanatomy and clinical report of intensity of pain. However, the amount of muscle damage measured using T2 weighted MRI images was correlated to pain drawing area.

**CLINICAL RELEVANCE:** Pain drawing area may provide a more accurate estimate of the extent/magnitude of pathoanatomic involvement than reports of pain intensity in LBP of muscular origin.

**OP02129**

**IDENTIFICATION AND EFFECTIVENESS OF PHYSICAL THERAPY INTERVENTION APPROACHES RELATED TO SACROILIAC JOINT DYSFUNCTION IN ADULTS INCLUDING THE PREGNANT POPULATION: A SYSTEMATIC REVIEW**

**Steiner L, Brudvig TJ, Saxena S, Sharma A**

Physical Therapy, Massachusetts General Hospital Institute of Health Professions, Boston, MA

**PURPOSE/HYPOTHESIS:** The purpose of this systematic review was to determine if physical therapy intervention is beneficial in the management of sacroiliac joint dysfunction and to determine which physical therapy interventions are effective in managing sacroiliac joint dysfunction in adults including the pregnant population.

**NUMBER OF SUBJECTS:** Twelve articles related to physical therapy intervention on sacroiliac joint dysfunction in the adult population to include the pregnant population were identified and reviewed. All 12 articles looked at the effect of physical therapy intervention on sacroiliac joint dysfunction as measured by the reduction in pain, disability, and laxity.

**MATERIALS/METHODS:** Two reviewers independently reviewed and scored the quality of evidence using the Evaluation Guidelines of MacDermid (2003) and Sackett’s levels of evidence. A third and fourth reviewer were consulted to resolve disagreements about a score or level of evidence.

**RESULTS:** Nine out of 12 studies looked at the pregnant population. Seven of these studies were randomized control studies, 1 was a quasi experimental study, and 1 was a case report. All were high quality studies. The interventions most beneficial in reducing pain and improving disability and laxity were specific stabilizing exercises, a non elastic pelvic belt, and muscle energy techniques. Three articles looked at the general adult population with sacroiliac joint dysfunction. Two of these studies were of moderate quality and 1 was a high quality case series. The most beneficial interventions included sacroiliac manipulation, soft tissue mobi-
This systematic review establishes and summarizes the evidence available on effective physical therapy strategies and interventions in managing sacroiliac joint dysfunction in both the general adult population and the pregnant population. This review provides current evidence to physical therapists to assist in their management of patients with sacroiliac joint dysfunction. The lack of studies in the general adult population indicates a need for future research to establish goals and a comprehensive treatment plan for the management of patients with sacroiliac joint dysfunction as a source of low back pain.

**OP02130**

**PRONE INSTABILITY TEST: PREDICTORS OF A POSITIVE TEST AMONG WORKING INDIVIDUALS WITH NONACUTE LOWER BACK PAIN**

David S, Mancinelli CA, Petronis JJ

**Human Performance and Exercise Science, West Virginia University, Morgantown, WV**

**PURPOSE/HYPOTHESIS:** To identify predictors of the prone instability test (PIT) in working individuals with nonacute lower back pain.

**NUMBER OF SUBJECTS:** One hundred seven (n = 107) subjects (48 women, 59 men) participated in the research investigation. The mean age was 32.8 years with a range of 19 to 50 years.

**MATERIALS/METHODS:** These data represent preliminary results from an ongoing research study funded by the National Institute for Occupational Safety and Health. Subjects were recruited from the local community to participate in the investigation based on the following inclusion criteria: age 18-50 years, greater than 3 weeks of lower back pain in the last year, currently working at least part-time outside the home, back pain that is affected by occupational exposure, back pain less than 7/10 at the time of testing, back pain not related to a motor vehicle accident, and no associated radicular symptoms below the knee. Data analysis consisted of logistic regression initially using a stepwise approach. The response variable was prone instability test (positive or negative test of at least 1 lumbar segment). The regressor variables included: current pain, hours worked per week, FABQ-Physical Activity (FABQ-PA), FABQ-Work (FABQ-W), hip IR ROM, straight leg raise greater than 90°, gait velocity (GAITRite), lumbar flexion ROM, lumbosacral angle, lumbar posture angle, and limits of stability (Balance Master) in backward directions for movement velocity (MVL) and directional control (DCL). To ensure adequate power, the number of regressor variables was limited to 15. The final model was analyzed for multicollinearity. A full model logistic regression analysis was performed to obtain p-values, unit odds ratios, and receiver operating characteristics.

**RESULTS:** The sample contained 31 (29%) individuals (15 women, 16 men) with a positive PIT of at least 1 lumbar spinal segment. Logistic regression revealed a model that contained FABQ-PA (P = .002), hours worked per week (P = .017), lumbosacral angle (P = .015), and limits of stability (DCL) in the right backward direction (P = .001). The model R-sq(U) was 0.24. The area under the ROC curve was 0.83. The model was found to have no significant multicollinearity.

**CONCLUSIONS:** The prone instability test is predicted by FABQ-PA, lumbosacral angle, limits of stability directional control in the right backward direction, and the number of hours worked per week in nonacute working individuals with lower back pain. The odds of a positive PIT increased with increases in hours worked per week, FABQ-PA, and lumbosacral angle. The odds of a positive test decreased as the DCL increased.

**CLINICAL RELEVANCE:** The results of this exploratory investigation may help improve our understanding of lumbar segmental instability in nonacute working individuals with lower back pain. The association of these variables with prone instability testing may serve to enhance future clinical prediction rules for this population.

**OP02131**

**CHANGE IN SPINE HEIGHT MEASUREMENTS FOLLOWING SUSTAINED MID-RANGE AND END-RANGE FLEXION OF THE LUMBAR SPINE AS A MEASURE OF INTERVERTEBRAL DISC HYDRATION**

Gerke DA, Brismeise JM, Sizer PS, Dedrick G, James CR

**Texas Tech University Health Sciences Center, Lubbock, TX**

**PURPOSE/HYPOTHESIS:** The purpose of this study was to investigate the effects of sidelying mid-range and end-range lumbar flexion positions on spine height changes as a clinical measure of intervertebral disc hydration. It was hypothesized that there would be an increase in spine height in sidelying flexion positions as compared to a sitting position and that there would be a difference in spine height change between the 2 sidelying flexion positions.

**NUMBER OF SUBJECTS:** Twenty women and 21 men, asymptomatic.

**MATERIALS/METHODS:** Spine height was measured using a digital stadiometer attached to a wooden frame. All measurements were taken with subjects sitting on a wooden platform. A familiarization period preceded the testing protocol.

**RESULTS:** Results of the paired t-tests indicated that compared to the spine height in sitting the sidelying end-range lumbar flexion position resulted in a statistically significant (P < .001) mean spine height gain of 4.78 mm (± 4.01) while the sidelying mid-range lumbar flexion position resulted in statistically significant (P < .001) spine height gain of 5.84 mm (± 4.4). No significant difference between the height changes observed following the 2 sidelying positions was found (P = .22). A paired t-test demonstrated a significant difference (P = .001) between the height gained in the first sidelying test position of 6.65 mm (± 3.99) and the height gained in the second test position of 3.97 mm (± 4.06).

**CONCLUSIONS:** End-range flexion positions were not significantly different than mid-range flexion positions in gaining spine height. These findings contrast with previous research reports that 20° of hyperextension in prone allowed subjects to gain height to a greater extent than other mid-range prone positions.

**CLINICAL RELEVANCE:** Clinicians can educate people to utilize mid-range or end-range lumbar flexion positions to increase spine height and possibly improve hydration levels of the lumbar intervertebral disc based on the most comfortable lumbar flexion position. As intervertebral disc degeneration can negatively affect the hydration levels of the disc and compromise its nutritional supply, the ability of the disc to rehydrate could allow the lumbar spine to withstand daily spinal loading and preserve a healthy environment for the lumbar intervertebral disc. These sidelying positions could offer a safe and comfortable alternative for patients with pregnancy, degenerative disc disease, acute low back pain or spinal stenosis that could benefit from increased spine height.

**OP02132**

**MUSCLE FUNCTIONAL MAGNETIC RESONANCE IMAGING (MFMRI) OF CERVICAL EXTENSOR MUSCLES DURING DIFFERENT CERVICAL EXTENSION EXERCISES IN ASYMPTOMATIC SUBJECTS**

Elliott JM, O’Leary SP, Cagnie B, Durbridge G, Danneels L, Jull G

**CRE-Spine, The University of Queensland, St Lucia, QLD, Australia; Centre of National Research on Disability and Rehabilitation Medicine, The University of Queensland, St Lucia, QLD, Australia; Centre for Magnetic Resonance, The University of Queensland, St Lucia, QLD, Australia; Department of Rehabilitation Sciences and Physiotherapy, Ghent University, Ghent, Belgium**

**PURPOSE/HYPOTHESIS:** To investigate the recruitment pattern of deep and superficial neck extensors during 2 different cervical extension exercises using muscle functional MRI (mMRI). It was anticipated that differ-
tial patterns of recruitment exist between the deep and superficial neck muscles when performing 2 different neck extension exercises.

**NUMBER OF SUBJECTS:** 11 healthy subjects (7 men [age, 34 ± 5.6 years] and 4 women [age, 23.3 ± 5.2 years]) with a group mean age of 30.1 ± 7.5 years. Exclusion criteria were recent neck pain, back pain or headache from cervical origin (<3 months) and contraindications to MRI.

**MATERIALS/METHODS:** mTRMRI was used to calculate shifts in T2-relaxation times (milliseconds) at the C2/3, C5/6, and C7/T1 segmental levels for the multifidus (Mul), semispinalis cervicis (SCs), semispinalis capitis (SCas), and the splenius capitis (SPc) muscles at rest and following 2 exercises: Cervical extension in craniocervical neutral (CECCN) and cervical extension in craniocervical extension (CECEE). Subjects performed 3 repetitions of each exercise at 20% Maximum Voluntary Contraction (MVC) effort. There was 30 seconds of rest between the repetitions for each exercise and 45 minutes of rest between the different exercises.

**RESULTS:** In the overall statistical model for increased T2 shifts, there was a significant level by exercise by muscle group interaction (P = .031). Compared with rest, the Mul/SCe and SCa displayed a significant T2 increase with each exercise at all levels (P < .05), except for the C2-C3 level during CECCN. For the SCa, the T2 increase during CECEE was significantly higher than during CECCN both at the C2-C3 level (P = .030) and the C5-C6 level (P = .018), whereas the Mul/SCe showed a higher T2 increase at the C7-T1 level during CECEE compared with CECCN (P = .003). No significant differences were noted across level or exercise for the SPc muscle.

**CONCLUSIONS:** This study showed that in vivo measures with mTRMRI can be used to characterize the specific activation levels and recruitment patterns of the superficial and deep neck extensor muscles during different cervical extension exercises in healthy subjects.

**CLINICAL RELEVANCE:** This study has indicated that variations in the performance of cervical extension will result in differing muscle recruitment patterns that should be considered when prescribing exercise for these muscle groups. Current research investigating T2-shifts in patients with neck disorders is underway.

**OP02133**

**USE OF A CLINICAL PREDICTION RULE FOR CERVICAL TRACTION IN CHRONIC HEADACHE: A CASE REPORT**

**Foreman E, Burns SA**

Therapies of Colorado, LLC, Denver, CO; Adjunct Faculty, Physical Therapy Program, University of Colorado-Denver, Denver, CO

**BACKGROUND AND PURPOSE:** A recent clinical prediction rule (CPR) was developed to identify individuals with neck pain who are likely to respond to cervical traction and exercise. The components of the CPR include age ≥55 years, peripheralization of symptoms with cervical (C4-7) mobility testing, positive shoulder abduction test, positive upper limb neurodynamic testing (ULNDT) with median nerve bias and positive neck distraction test. There have not been any reports about its application to the chronic headache (HA) population. The purpose of this case report is to describe the use of the CPR in the management of an individual with chronic HAs with upper extremity neurological symptoms.

**CASE DESCRIPTION:** A 57-year-old male with a 17-year history of daily headaches, constant neck pain and bilateral upper extremity (UE) neurologic symptoms in the median nerve distribution. His symptoms had progressively worsened despite multiple bouts of conservative care and a series of injections. Initial outcome measures included Neck Disability Index (NDI) of 28%, average numeric pain rating scale (NPRS) of 5/10, fear-avoidance beliefs questionnaire (FABQ) work of 12 and physical activity of 9. Physical examination findings included limited neck movements with extension reproducing concordant neck and UE symptoms, Spurlings (–), positive ULNDT with median nerve bias, peripheralization with mobility testing from C5-T4 and positive neck distraction test. According to the CPR by Raney et al in 2009, this individual met 4 out of the 5 variables for intermittent cervical traction and exercise which yields a post test probability of 95% chance of achieving a +6 or greater score on the Global Rating of Change (GRC). Treatment consisted of 4 visits of intermittent cervical traction, deep neck flexor (DNF) strengthening in supine, active median nerve glides, postural education and cervical muscle stretching. Intermittent cervical traction was performed using Saunders cervical traction portable unit twice per week for 2 weeks. Parameters for intermittent traction were 60 seconds at 20 lb tension followed by 20 seconds at 0 lb for 15 minutes. DNF strengthening included 10 repetitions for 10 second hold in supine. Cervical muscle stretching included bilateral upper trapezius, scalene and levator scapulae. All of the above were performed twice daily as part of a home exercise program with the exception of cervical traction.

**OUTCOMES:** Significant improvements were seen at the end of 2 weeks. Outcome measures at discharge were NDI = 0%, average NPRS = 0/10 and a GRC score of +7 or “a very great deal better.” At discharge, he only had 1 positive test for the CPR which was age ≥55. Cervical range of motion improved and extension did not reproduce any symptoms. These results were maintained at 4-month follow-up.

**DISCUSSION:** In this case, the utilization of this CPR yielded a successful outcome in an individual with chronic HAs that had been recalcitrant to other forms of conservative care. To our knowledge, this is the first case report to illustrate effective usage of the variables outlined by this CPR.

**OP02134**

**THE ROLE OF APPROPRIATE SITTING POSTURE IN FACILITATING SELECTIVE BIOMECHANICAL AND NEUROMECHANICAL VARIABLES ASSOCIATED WITH UPPER QUARTER FUNCTION**

**Friberg RJ, Thurmond S, Palmer PB, Bosser K, Byerds S, Laker L, Osborne D**

Department of Physical Therapy, Hardin-Simmons University, Abilene, TX

**PURPOSE/HYPOTHESIS:** To determine if proprioceptive neuromuscular facilitation (PNF) treatment to the cervical spine had an effect on recruitment of cervical segments (sustained cervical segmental axial retraction (SCSAR) and select measures of neuro- and biomechanical dysfunction (ie, pinch and grip strength, scores on the Neck Disability Index (NDI), and neural provocations tests for the ulnar and median nerves).

**NUMBER OF SUBJECTS:** 51 subjects (male, 13; female, 38) volunteers (mean ± SD age, 23.2 ± 8.0) participated.

**MATERIALS/METHODS:** Participants signed an informed consent, provided demographic information, and completed the NDI. Pinch and grip strength were assessed, and neural tension tests for ulnar and median nerves were performed. All tests were performed bilaterally. SCSAR was completed by an experienced clinician for each participant and the number and location of inhibited segments from C3 to C7 were identified. Participants were randomly assigned to 1 of 3 treatment groups. All participants received instruction in appropriate sitting, while group B received additional instruction in self-facilitation for cervical inhibition, and group C was taught self-facilitation and PNF protocols. Seven days later, subjects returned for reassessment.

**RESULTS:** A repeated-measures ANOVA was performed using SPSS 16.0. The model included 2 within-subject factors (time and time by group) and 1 between-subject factor (Group). Wilks’ lambda was used as the test statistic since Box’s M could not be computed and equal variances could not be assumed. There was no significant interaction between time of administration of the measures (time) and group assignment (P = .379) and no significant difference based on group assignment (P = .207) on the combination of dependent variables. There was, however, a significant difference between pretest and posttest measures (P < .001) Univariate tests indicated a significant difference between pretest and posttest on the following measures: right grip strength (P = .001), left grip strength (P < .001), right ulnar tension test (P = .01), left ulnar tension test (P = .006), right median tension test (P = .003), left median tension test (P = .002), scores on the NDI (P = .007), and the number of dysfunctional
PURPOSE/HYPOTHESIS: The changes in the dependent variables were most likely neuromechanical rather than biomechanical since changes in strength and range of motion do not occur this quickly. Clinically, SCSAR is utilized to identify the presence of a neuromechanical component related to peripheral weakness or an inhibited response secondary to faulty body mechanics. We feel that the use of appropriate sitting posture, the common intervention for all 3 groups, may explain the improvement from pretest to posttest in this study. Further research is warranted to study this assertion.

CLINICAL RELEVANCE: Appropriate posture has a positive effect on maintaining facilitation from a biomechanical and neuromechanical standpoint, therefore, improving upper quarter function.

MANUAL PHYSICAL THERAPY APPROACH IN THE TREATMENT OF LOW BACK PAIN IN A PREGNANT FEMALE WHO MEETS A CLINICAL PREDICTION RULE: A CASE REPORT
Garvey C
KORT, Louisville, KY

BACKGROUND AND PURPOSE: To describe the examination, clinical decision making and manual physical therapy (MPT) interventions for a pregnant female with low back pain (LBP) utilizing thrust manipulation in the context of a clinical prediction rule (CPR). Currently, there are few moderate quality studies examining the use of manual physical therapy interventions in the treatment of pregnancy related LBP, even fewer with consistent outcome measures and patient descriptions. This case utilizes outcome measures and a CPR to guide decision making for inclusion of MPT.

CASE DESCRIPTION: A 33-year-old female beginning her fourth month of pregnancy presented to physical therapy with a 10-day history of insidious onset unilateral buttock/LBP with no radicular symptoms. Her pain was better in the evening and with sitting and worse in the morning and with activity. She had a previous bout of similar LBP at the end of her previous pregnancy over 2 years ago with resolution upon birth. Physical therapy examination revealed prone L3-5 hypomobility to PA assessment, (+) ipsilateral FABER test, and prone asymmetric IR PROM. Her Oswestry Disability Index (ODI) was 6% and Fear Avoidance Belief Questionnaire, Work Subscale (FAQ/W) was 0. Patient Specific Functional Scale, 0/10 is able to perform normally and 10/10 is unable to perform said activity, was ranked as follows: picking up her toddler 6/10, standing 4/10, walking 6/10. Due to the patient meeting 4/5 predictors of a validated CPR, a thrust manipulation was performed bilaterally followed by ROM exercises and, eventually, core strengthening exercises.

OUTCOMES: A complete resolution of symptoms, ODI 0%, and 0 average PSFS followed 4 visits over 19 days. A follow-up at 6 months confirmed a stable resolution of symptoms with her home exercise program performed as needed.

DISCUSSION: This patient experienced a rapid and clinically meaningful improvement in function and pain after receiving thrust manipulation, ROM exercises, and core strengthening in line with meeting a CPR.

CLINICAL RELEVANCE: This case report describes the use of manipulation in the treatment of LBP in a pregnant female who met a CPR. Future research should investigate the effects of this management strategy in a larger sample size and relative to standard care.

SPINAL AND HIP FLEXION END-RANGE OF MOTION WITH FORWARD BENDING IN 2 LOW BACK PAIN SUBGROUPS BASED ON THE MOVEMENT SYSTEM IMPAIRMENT MODEL
Program in Physical Therapy, Washington University School of Medicine, St Louis, MO; Department of Physical Therapy, Kyoto University, Kyoto, Japan

PURPOSE/HYPOTHESIS: It is proposed that low back pain (LBP) subgroups based on the Movement System Impairment (MSI) model display different amounts and patterns of trunk movement. Using this model, patients are assigned to the Rotation (Rot) subgroup if they report symptoms and display impairments with flexion, extension, and rotation. Patients are assigned to the Rotation with Extension (RotExt) subgroup if they report symptoms and display impairments with only extension and rotation. Our purpose was to examine differences in the amount of spinal and hip flexion end-range of motion (ROM) with forward bending between the 2 LBP subgroups. We hypothesized that the Rot subgroup would demonstrate greater lumbar flexion ROM than the RotExt subgroup.
NUMBER OF SUBJECTS: Forty-three subjects (25 Rot, 18 RotExt; age, 43.3 ± 10.8 years) with chronic LBP were studied.

MATERIALS/METHODS: Each subject was examined and subgrouped based on the MSI model for LBP. Three-dimensional kinematic data were collected during the forward bend test. Symptoms were recorded. Initial and final angular positions of the thoracic segment, lumbar segment, and hip were calculated. Independent samples t tests were used to compare continuous variables and a chi-square test for independence was used to compare nominal data between the 2 subgroups. Alpha was set at P<.05 for all tests.

RESULTS: There were no differences between subgroups in initial thoracic, lumbar, and hip angles (P>.05). The Rot subgroup demonstrated greater final lumbar flexion (11.0° ± 5.8°) than the RotExt subgroup (6.9° ± 7.8°; P = .05). There were no differences in the amounts of final thoracic and hip flexion between subgroups (P>.05). A greater percentage of subjects in the Rot subgroup (68.0%) reported an increase in symptoms with forward bending compared to those in the RotExt subgroup (33.3%; P = .05).

CONCLUSIONS: Subjects in the Rot subgroup used more lumbar flexion ROM with forward bending than subjects in the RotExt subgroup. Because final thoracic and hip flexion amounts were the same, the greater final lumbar flexion in the Rot subgroup was not likely the result of a limitation in hip or thoracic motion. The Rot subgroup was also more likely to experience an increase in symptoms with the forward bending test.

CLINICAL RELEVANCE: These findings support that the proposed LBP subgroups differ in predictable ways, providing additional evidence that the groups are distinct. Because the Rot subgroup demonstrated greater end-range lumbar flexion and were more likely to report an increase in symptoms with forward bending than the RotExt subgroup, end-range lumbar flexion may be particularly important to consider in intervention for people in the Rot subgroup compared to people in the RotExt subgroup.

OP02139

CONCURRENT VALIDITY OF GONIOMETRY AND 3-D MOTION ANALYSIS FOR ASSESSING PELVIC MOTION DURING THE “BENT KNEE FALLOUT” TEST

Hovore D, Cinotto J, Harsham H, Stanberry D, Woodward S
Physical Therapy Education, Rockhurst University, Kansas City, MO; Rush University Hospital, Chicago, IL; Indiana Physical Therapy, Fort Wayne, IN; St Joseph Sport and Physical Therapy, Kokomo, IN; Bearcat Physical Therapy, Wheeler, IN

PURPOSE/HYPOTHESIS: Research suggests movement impairment syndromes (MIB) contribute to musculoskeletal dysfunction. As a means of assessing MIB, Sahrmann describes the “bent knee fallout” (BKFO) for assessing the ability of the abdominal and spinal musculature to stabilize the pelvis during motion of the lower extremity. The BKFO is used clinically via palpation and visual inspection, and patients are then assessed on a dichotomous scale, as either showing pelvic motion or not, and as having pain or not. A recent study found that goniometry provided greater measurement sensitivity for assessing the BKFO. The aim of the present study was to compare the validity of the goniometric method to a 3-D motion analysis system.

NUMBER OF SUBJECTS: Three males and 11 females age 21 to 34 years (mean, 23.57; SD, 2.12) participated.

MATERIALS/METHODS: The spine, pelvis, and lower extremities were tracked using a 3-D motion analysis system as participants performed the BKFO. Instructions were given and performance was assessed as each participant performed 5 BKFO trials bilaterally. Participant performance was assessed on a dichotomous scale, as either showing pelvic motion or not, and as having pain or not. A recent study found that goniometry provided greater measurement sensitivity for assessing the BKFO. The aim of the present study was to compare the validity of the goniometric method to a 3-D motion analysis system.

RESULTS: Concurrent validity was calculated by comparing the goniometry measures to the values captured simultaneously with the 3-D motion analysis system. High intrarater reliability was found for goniometry using Chronbach’s alpha (range, .47-.93; mean, 0.81; SD, 0.09) and ICC (range, .47-.93; mean, 0.74; SD, 0.15). Low intrarater reliability was found for goniometry using 1-way random ICC (single measure: F = 6.06, P = .813 and F = .568, P = .842 on the right and left, respectively). Statistically significant differences were found between goniometry and the 3-D motion analysis on both lower extremities. One-way random intra-class correlation coefficients (single measure: F = 2.031, P = .067 and F = 3.572, P = .012 on the right and left, respectively) also indicated that the
PERIPHERAL AND CENTRAL SENSITIZATION IN INDUCED LOW BACK PAIN
Horn ME, George SZ, Bishop MD
University of Florida, Gainesville, FL
PURPOSE/HYPOTHESIS: The current study investigated plasticity of pain perception using evoked pain responses in the presence of induced musculoskeletal pain. Persistent pain may largely be driven by central sensitization of the central nervous system (CNS). “Wind up” is a measure of central sensitization and is characterized by a progressive increase in output from dorsal horn neurons in animals. Temporal sensory summation (TSS) is a proxy measure of “wind-up,” which can be measured in humans. Of primary interest in this current study was whether TSS was facilitated in subjects complaining of pain relative to those who did not, after completing a protocol designed to induce low back pain (LBP).
NUMBER OF SUBJECTS: 52 participants (aged 22.4 ± 3.9 years, 24 female) read and signed a consent form approved by the local IRB.
MATERIALS/METHODS: A thermally evoked pain protocol to elicit TSS consisting of 10 consecutive 50°C pulses was used on the posterior leg of each participant. Subjects were asked to report their pain on a numeric rating scale of 0 to 100 (0 = no pain, 100 = worst pain imaginable) after each pulse. Mechanical pressure pain threshold (PPT) was measured using an algometer in lumbar paraspinal musculature at the levels of T12 and L5. Both measurements were made at baseline and 48 hours post exercise. The exercise used to induce delayed onset muscle soreness in the trunk extensor muscles. Pain intensity in the back 48 hours after exercise was measured using a 100-mm visual analog scale (VAS). Participants were separated into 2 groups based on this report: high pain intensity (>35/100 on the VAS; n = 8) and low pain intensity (≤5/100; n = 14) after exercise. This criterion was selected because 35 mm represents meaningful change in pain for patients with acute LBP. The remaining subjects (n = 30) were not included in subsequent analyses. The high and low pain intensity groups were compared for differences in TSS and PPT at baseline and 48 hours after exercise using separate 2-way mixed-model analyses of variance.
RESULTS: For TSS there was a significant interaction (F_{1,19} = 5.68, P = .030) between time and group in which the high pain group experienced greater TSS 48 hours after exercise. No interaction was noted for PPT; however, there was a main effect for time (F_{1,19} = 12.8, P = .002) in which thresholds were reduced at 48 hours for both groups.
CONCLUSIONS: These findings suggest that both groups experienced mechanical hyperalgesia, suggesting peripheral sensitization. However, those people who had central sensitization of the CNS, indicated by facilitated temporal summation, reported high pain intensity. Future work will examine how baseline characteristics of nociception and perception might predict the development of musculoskeletal pain.
CLINICAL RELEVANCE: Application of interventions that target central sensitization may be useful in acute LBP to prevent the progression to persistent pain states.
A CASE OF ADHESIVE CAPSULITIS MASKING OCCULT ANKYLOSING SPONDYLITIS: DIFFERENTIAL DIAGNOSIS AND MANAGEMENT

Jordan C, Rhon D

Physical Medicine, Madigan Army Medical Center, Tacoma, WA

BACKGROUND AND PURPOSE: To describe the evaluation, differential diagnosis, and intervention of a patient with adhesive capsulitis of the shoulder and an occult systemic spondyloarthropathy.

CASE DESCRIPTION: A 32-year-old male with a 5-year history of right shoulder pain and decreased range of motion was referred from primary care to physical therapy for adhesive capsulitis. He denied lumbar or sacral spine pain and reported normal mobility of the left shoulder. His symptoms were refractory to conservative treatment consisting of shoulder strengthening, stretching, and manipulation in addition to evaluation and care from orthopedic and chiropractic providers. Magnetic Resonance Imaging from 3 years prior revealed a partial infraspinatus tear, a Hill-Sachs lesion, and synovitis in the shoulder.

OUTCOMES: In addition to glenohumeral capsular restrictions, significant findings on evaluation by the physical therapist included severe shoulder pain and reported normal mobility of the left shoulder. Radiographs revealed a partial infraspinatus tear, and synovitis in the shoulder.

CONCLUSIONS: Both tests had moderate to good reliability. The sitting test had higher reliability and is performed in a functional position, is of clinical relevance.

CLINICAL RELEVANCE: A test with good reliability may be clinically useful in evaluating individuals with neck pain.

OUTCOMES FOLLOWING THE ADDITION OF THORACIC THrust MANIPULATION TO A MULTIModal APPROACH FOR A PATIENT WITH CHRONIC MECHANICAL NECK PAin: A CASE STUDY

Kelm CL, Mullenbach E, Erickson M

Carroll University, Waukesha, WI

BACKGROUND AND PURPOSE: Chronic neck pain affects 54.2% of adults and results in functional limitations and disability that impact quality of life and generate significant economic burden. A thorough literature review, while supporting thoracic thrust manipulation (TTM) for patients with acute neck pain, did not identify any studies exploring the efficacy of TTM for patients with chronic mechanical neck pain (CMNP). Further, no studies assessed the efficacy of TTM when combined with other interventions supported by the published physical therapy clinical practice guidelines (CPG) for patients with neck pain (JOSPT, 2008). The purpose of this study was to assess outcomes following TTM combined with multimodal physical therapy (PT) based on the PT CPG for a patient with CMNP.

CASE DESCRIPTION: A 58-year-old male with CMNP was seen for 10 visits by a student physical therapist on her final internship. Multimodal interventions were prescribed based on examination findings and consisted of stretching, strengthening, soft tissue mobilization emphasizing sustained deep pressure for trigger point deactivation, ultrasound, neural mobilization, breathing and posture education, and thoracic posterior-anterior manual mobilization that was progressed to grade V thrust technique. Therapeutic exercises were performed independently as a home program. Functional limitation, disability, and impairment status were quantified prior to and after intervention with the validated Northwick Park Neck Pain Questionnaire (NPNPQ); Neck Disability Index (NDI); and Patient Specific Functional Scale (PSFS); along with patient-reported percentage of normal function; self-reported neck pain, and neck AROM, PROM, and muscle performance.

OUTCOMES: Post intervention examination revealed an increase in self-perceived functional status from 5% to 96% of normal; decreased neck pain from 5/10 to 1/5/10; increased neck AROM in all planes ranging from 22% to 52% (mean 36%), increased neck strength in all muscle groups ranging from 4% to 100% (mean 57%), and an 80% increase in neck muscle endurance. The patient experienced a 12-point reduction in disability, out of 50 point scales on both the OSW and the NDI, a 7-point decrease on the NPNPQ, and an 80% improvement on all PSFS abilities.

DISCUSSION: Physical therapists commonly use a variety of approaches in the management of patients with neck pain. To establish physical therapists as evidence-based practitioners, it is essential to examine outcomes following interventions administered simultaneously in various combinations, a strategy commonly employed in clinical practice. No previously published studies have evaluated TTM in combination with other CPG recommended interventions. This case study describes a positive outcome for a patient with CMNP following a PT plan of care based on the PT CPG. It provides direction for both clinical practice and future research to further delineate best practice in an effort to facilitate efficient, evidence-based, and cost effective care.
SUBCLAVICULAR AND NECK PAIN MANAGED BY MANIPULATION AND TRIGGER POINT DRY NEEDLING
Krum L, Flynn T
School of Physical Therapy, Regis University, Denver, CO

BACKGROUND AND PURPOSE: A myriad of disorders can give rise to anterior neck and chest wall pain. Musculoskeletal causes of these pain patterns are often misdiagnosed. A potential pain generator is the subclavichord muscle which is innervated by the nerve to the subclavius (C5, 6). The purpose of this case study is to describe the management of an individual with chronic subclavicular pain.

CASE DESCRIPTION: A 39-year-old female with insidious onset of unremitting left anterior neck pain and subclavicular pain following a sinus infection was referred to physical therapy 4 weeks post onset of symptoms. Patient Specific Functional Scale (PSFS) score on initial exam was 1/10. Pain with shoulder elevation/depression was 8/10 on a Numeric Pain Rating Scale (NPRS). Treatment by the first physical therapist (PT) included a indirectly manipulated technique in sitting to T1 and supine to the first rib; trigger point dry needling (TPDN) to upper trapezius (UT) and levator scapula (LS), and tape to elevate the shoulder girdle. No change in pain occurred after 4 sessions (2 weeks). She was referred to a physiatrist who ordered a MRI of the cervical spine, upper thoracic spine, and binalar plexus, and performed trigger point injections (Lidocaine) to the UT, LS, anterior scalene (AS) and sternocleidomastoid (SCM). Patient was also placed on a Medrol dose pack for 6 days. MRIs revealed an os odontoideum, moderate to severe degenerative change at C7-T1 costovertebral joints and slight left foraminal narrowing at C7-T1. A referral was made to a hematological oncologist to rule out cancer due to an abnormal left supraclavicular lymph node on imaging, and to an anesthesiologist for consultation on pain management. Patient sought a second opinion from another PT. Exam at 8 weeks post onset of symptoms revealed PSFS at 1/10 and NPRS at 8/10, hypermobility in the upper cervical spine, hypomobility in the UT, LS, AS, middle scalene, and SCM on the left and hypomobility in C4-C5, C6-T1, second rib, and SC joint. Neurorotemose sensory screen WNL.

OUTCOMES: Session 1 included a supine inferior glide mobilization of the lateral aspects of the left 1 and 2 ribs and a cervical traction manipulation targeted to the zygapophyseal and uncovertebral joints of the left C4-5 and C5-6 segments. The patient was educated on the probable source and the musculoskeletal behavior of the pain. PSFS and NPRS improved to 4.5/10 and 5/10, respectively. Session 2 included a supine inferior glide mobilization of the lateral aspects of the left 1 and 2 ribs, cervical traction manipulation of the left C4-5 and C5-6, and TPDN to the subclavius muscle. PSFS and NPRS improved to 8.7/10 and 1/10, respectively.

DISCUSSION: We describe a case that is consistent with a subclavious muscle and C5-6 dysfunction which was successfully managed with thrust manipulation and TPDN. Without a precise diagnosis for the pain syndrome, a series of escalating medical decisions led to increased imaging and medical intervention. These additional tests and interventions delayed successful management by a physical therapist.

THE EFFECT OF INITIAL POSTURE ON THE PERFORMANCE OF MULTIJOINT REACHING TASKS: A COMPARISON OF JOINT EXCURSIONS BETWEEN INDIVIDUALS WITH AND WITHOUT CHRONIC LOW BACK PAIN
McCullum AI, Johnson EN, Sabo B, Thomas JS
Physical Therapy, Ohio University, Athens, OH

PURPOSE/HYPOTHESIS: The aim of this study was to determine the effect of initial posture (ie, standing versus sitting) on movement strategy in individuals with and without chronic low back pain (LBP). We hypothesized that participants would demonstrate a decrease in lumbar spine excursions in standing reaching tasks compared to sitting reaching tasks. In addition, chronic LBP participants would exhibit a decrease in lumbar spine excursions compared to healthy individuals. The rationale for this hypothesis is that sitting eliminates the degrees of freedom (DOF) of the knees and ankles resulting in an increased reliance on the excursions of the lumbar spine to reach the target.

NUMBER OF SUBJECTS: Thirty-six participants (18 healthy, 18 chronic LBP) between the ages of 18–37.

MATERIALS/METHODS: Target locations were determined from anthropometric measurements to standardize reach distance across participants. For example, each participant could theoretically reach the high target with their upper extremity fixed in 90° of shoulder flexion, hips flexed 15° with respect to the vertical plane with no movement of the spine, knees, or ankle. Middle and low targets could be reached with 45° of hip flexion and 60° of hip flexion, respectively. Joint motions were measured using The Motion Monitor, a magnetic-based kinematic system. Mixed-model ANOVAs were used to analyze joint excursions across the conditions of group, target height, and initial posture.

RESULTS: There was a significant effect of initial posture on lumbar excursions (F = 31.99, P < .05). While initial posture influenced lumbar excursions, there was no main effect of group on lumbar flexion. Further, there were no significant interactions of group by target height or group by initial posture.

CONCLUSIONS: Contrary to expectations, lumbar flexion excursions were greater in standing reaching trials compared to sitting. While previous studies from our lab have shown group differences in lumbar excursions in these tasks, this finding was not supported by this study. It could be
due to the relatively low level of disability amongst our low back pain group.

**CLINICAL RELEVANCE:** LBP is one of the most prevalent musculoskeletal problems in the US. It is important to understand and gain further clarification through the conduction of additional research on how individuals with chronic LBP adapt their movement strategy under different conditions during dynamic reaching tasks.

**OP02148**

A PRELIMINARY INVESTIGATION USING REHABILITATIVE ULTRASOUND IMAGING TO MEASURE MUSCLE MORPHOLOGY OF THE LOCAL STABILIZERS IN SUBJECTS WITH AND WITHOUT CHRONIC NECK PAIN

*McEwagh J, Ellison J*

University of Texas Medical Branch at Galveston, Galveston, TX, USA

**BACKGROUND CONTEXT:** Rehabilitative Ultrasound imaging (RUSI) has been identified as a noninvasive technique used to measure muscle morphology in both static and dynamic conditions. Current evidence suggests that subjects with spinal pain often present with altered morphology and activation of the deep spinal muscles that function to provide segmental control and stability. It has been estimated that 80% of the mechanical stability of the cervical spine comes from the surrounding neck musculature. The local stabilizers of the cervical spine are the deep neck flexors (longus capitis and longus colli) and the deep neck extensors (semispinalis and multifidus).

**PURPOSE:** The purpose of this preliminary investigation was to measure and compare the cross sectional area (CSA) of the deep neck flexors and the deep neck extensors in subjects with and without chronic neck pain.

**PATIENT SAMPLE:** The cross sectional area of the deep cervical flexors and deep cervical extensors were measured in 5 female symptomatic subjects with chronic neck pain greater than 6 months (age, 34.60 ± 11.88 years) and 5 female subjects without a history of neck pain (age, 31.00 ± 12.16 years). There was no statistical difference based on age between the 2 groups.

**OUTCOME MEASURES:** Mann-Whitney U test.

**METHODS:** The subjects were measured for both the right and left muscle groups at approximately the level of the fourth cervical vertebra using the GE Medical System Logic 9 Ultrasound system, with a M7C probe at 7MHz. CSA (cm²) were measured by tracing the inner edge of the muscle border and used for data analysis to quantify muscle volume for the deep neck flexors, deep neck extensors, and cervical multifidus. A total of 4 measures were recorded for each muscle group and averaged for statistical analysis. Data analysis included both right and left sided measures.

**RESULTS:** Comparison of the muscle size between groups, the subjects with chronic neck pain demonstrated smaller CSA of all muscle groups measured. The CSA for the deep neck flexors for pain subjects was 0.69 ± 0.08 compared to 0.92 ± 0.18 for control subjects (P = .009). The CSA for the deep neck extensors group for pain subjects was 2.14 ± 0.27 compared to 4.73 ± 2.70 for control subjects (P = .023). The CSA for the cervical multifidus for pain subjects was 0.95 ± 0.18 compared to 1.17 ± 0.14 for control subjects (P = .03).

**CONCLUSIONS:** This pilot investigation suggests that the deep spinal muscles are smaller in subjects with chronic neck pain when compared to age matched controls.

**OP02149**

IMMEDIATE EFFECTS OF THORACIC TRANSVERSE MOBILIZATION IN PATIENTS WITH THE PRIMARY COMPLAINT OF MECHANICAL NECK PAIN: A PILOT STUDY

*Murahashi L, Sena T, Yarnall B, Boyles R, Benson-McGregor CJ*

Physical Therapy, University of Puget Sound, Tacoma, WA

**PURPOSE/HYPOTHESIS:** While studies support manual therapy to the upper thoracic spine as effective intervention for mechanical problems of the cervical spine, no published studies were found that specifically examined the Maitland technique of transverse pressures in this regard. Our purpose was to explore the immediate effects of thoracic transverse pressures on cervical range of motion (ROM) and pain among subjects with mechanical neck pain.

**NUMBER OF SUBJECTS:** The treatment group consisted of 21 subjects, 14 females and 7 males, aged 20 to 37 with a mean age of 30, who reported mechanical neck pain that increased with active neck movements. Excluded were subjects with complaints suggestive of radiculopathy, myelopathy, peripheral nerve involvement, irritable condition or nonmechanical behavior. A control group of 20 asymptomatic subjects were included to ensure rater blinding and to further indicate accuracy of the rater.

**MATERIALS/METHODS:** In our single-blind study, the treatment group received grades IV to IV+ transverse mobilizations from T1 through T4 bilaterally in 30-second increments for a total of 8 minutes. The control group simply assumed the prone position for 8 minutes. Measurements included pre/post cervical ROM in 6 directions using an inclinometer and goniometer, pressure pain threshold (PPT) using a digital algometer, and report of pain using an 11-point numerical pain rating scale (NPRS). Analysis included paired t tests for ROM and PPT scores, and Wilcoxon Signed Ranks Test for modified NPRS scores.

**RESULTS:** The transverse group demonstrated significant gains in extension and bilateral rotation (P < .005) and in left sidebending (P = .014). Differences in flexion and right sidebending were not significant. One subject required handling with intention to treat. The control group had no statistically significant differences in any motions (P > .05) or in PPT scores. Unlike some studies using grade V techniques, grade IV mobilization did not significantly increase PPT scores. None of the PPT difference scores exceeded the previously reported instrument measurement error of 1.78 kg/cm² although raw scores increased in 81% of experimental subjects as compared to 30% of controls. Within the NPRS criterion of at least a 2-point change for a minimally clinically important difference, decreased pain was indicated in the majority of transverse group scores (Wilcoxon 0.001); no increased pain was indicated.

**CONCLUSIONS:** Eight minutes of transverse mobilization to the upper thoracic spine resulted in highly significant gains in cervical extension and bilateral rotation and also decreased pain.

**CLINICAL RELEVANCE:** These results support application of transverse pressures to the thoracic spine as an appropriate intervention among patients with mechanical neck pain.

**OP02150**

LUMBOPELVIC KINEMATICS IN THE PRESENCE OF DIMINISHED HIP MUSCLE PERFORMANCE

*Popovich J, Kulig K*

Biokinesiology & Physical Therapy, University of Southern California, Los Angeles, CA

**PURPOSE/HYPOTHESIS:** Weakness at the hip results in a contralateral drop of the pelvis observed during single-leg postures and activities. Trunk motion, opposite to the side of the pelvis drop, is a common adaptation producing a shift of the center of mass over the base of support. However, the relation between hip muscle performance and lumbo pelvic mechanics remains uncharted. Therefore, the purpose of this investigation was to determine the effect of diminished hip muscle performance on lumbo pelvic mechanics with the hypothesis that individuals with diminished hip muscle performance will demonstrate greater excursion and peak amplitudes of lumbo pelvic kinematics.

**NUMBER OF SUBJECTS:** Two groups (Strong Group-SG and Weak Group-WG) of individuals participated in this study. The WG consist of individuals with diminished hip muscle performance (n = 2) while the SG served as controls (n = 2).

**MATERIALS/METHODS:** Hip muscle performance was assessed by averaging 3 trials of isometric hip dynamometry on a Primus RS dynamometer (BTE Technologies), testing hip abduction and hip extension isometric strength. Three dimensional kinematics were recorded at a sampling...
rate of 120 Hz, using a Vicon motion analysis system (Oxford Metrics, Ltd.). Fourteen-mm spherical reflective markers were used to create a lower extremity and lumbopelvic trunk kinematic model. In order to express lumbopelvic motion, local coordinate systems for the pelvis and lumbopelvic trunk were created, and motion was described as the lumbopelvic trunk segment relative to the pelvis segment. Subjects performed a demanding single-leg landing task, selected to challenge the hip musculature. This task was repeated 5 times for each lower extremity. Lumbopelvic kinematics were calculated using Visual 3D (C-Motion, Inc) software.

RESULTS: The WG demonstrated lower isometric hip abduction strength (30.6%) and isometric hip adduction strength (37.6%). During the single-leg landing task, the WG demonstrated an increase in lumbopelvic sagittal (30.8%), frontal (53.7%), and transverse (38.0%) plane excursion when compared to the SG. The WG also demonstrated 4-times greater peak frontal plane lumbopelvic motion than those in the SG.

CONCLUSIONS: These findings are in support of the proposed hypothesis, suggesting a link between diminished hip muscle performance and increases in lumbopelvic kinematics. This experimentation serves as the basis for continued investigation into understanding the effects of lower extremity weakness on human movement.

CLINICAL RELEVANCE: Lumbar excruciating and peak amplitude appear to be greater in persons with diminished hip muscle performance. Further investigations into the potential mechanisms of injury and spinal loading are required to understand the consequences of increased lumbopelvic kinematics.

THE RELATIONSHIP BETWEEN NORMALIZED LUMBAR MUSCLE SURFACE EMG AND WEIGHT CONDITION DURING PRONE LEG RAISES: A PILOT STUDY

OPO2152

Poulsen K, Mandell J, Dawkins S
School of Health and Medical Sciences, Seton Hall University, South Orange, NJ

PURPOSE/HYPOTHESIS: The purpose of this pilot study was to validate a methodology for producing graded muscle contractions in the lumbopelvic spinae that correlate with surface electromyography (sEMG) data. This methodology, if found to be appropriate, could then be included in a larger study examining reliability of manual palpation.

NUMBER OF SUBJECTS: Five (5).

MATERIALS/METHODS: Surface EMG was collected during resisted prone trunk extension to establish a maximum voluntary contraction (MVC), and also when subjects performed prone leg raises with ankle weights during a 1 repetition maximum (ORM). Weight conditions were determined as 25%, 50%, 75%, and 100% of the subject’s predetermined ORM. Subjects performed 16 total leg raises, with 4 trials in each of the 4 weight conditions. Surface EMG data were recorded from the left erector spinae muscle using Noraxon Telemetry equipment. Surface EMG data were filtered, rectified, and smoothed, then normalized to the MVC. Association between leg weight condition and sEMG activity was determined by linear regression analysis.

RESULTS: Data were examined on both a trial-by-trial basis and as an average value for each weight condition. Linear regression analysis of average sEMG versus weight condition by subject number: 1, R² = 0.906 (P = .048); 2, R² = .819 (P = .095); 3, R² = .238 (P = .512); 4, R² = .648 (P = .195); 5, R² = .829 (P = .09). Linear regression analysis of trial-by-trial sEMG versus weight condition by subject number, 1, R² = .326 (P = .021); 2, R² = .500 (P = .002); 3, R² = .077 (P = .296); 4, R² = .069 (P = .324); 5, R² = .305 (P = .026).

CONCLUSIONS: There was poor agreement between the weight conditions and the amount of muscle activity recorded by sEMG. The data recorded during each weight condition were highly variable both within and between subjects. The variability in the sEMG data suggests that subjects used different strategies to stabilize the lumbar spine. Some of the variability in the data might be accounted for by measuring another muscle; a primary mover, such as the quadriceps femoris during a seated knee extension task. On several trials, the sEMG activity recorded during the leg raises far exceeded 100% of the sEMG activity recorded during the MVC, indicating that a true MVC was not achieved during the prone trunk extension task. Use of a hand-held dynamometer for establishment of the ORM should be considered in future research. Weighted prone right leg extension does not result in predictably graded muscle contractions in the left lumbopelvic erector spinae muscle. This methodology is not valid for use as part of a larger research design relying on correlation between lumbopelvic erector spinae muscle sEMG and a weighted leg raise task.

CLINICAL RELEVANCE: This pilot study illustrates the challenges in assessing lumbopelvic spinae muscles during repeated leg-raise with weights: Even under same weight condition large variability were found during repeated trials. This study assists in directing future research to establish the reliability of manual palpation of contracting muscles as a clinical tool.

THE RELATIONSHIP BETWEEN LUMBOPELVIC MOTION DISPLAYED DURING ACTIVE AND PASSIVE HIP LATERAL ROTATION IN PEOPLE WITH AND PEOPLE WITHOUT LOW BACK PAIN

OPO2151

Scholtes SA, Norton BJ, Gombatto S, Van Dillen LR
Washington University, St Louis, MO; Physical Therapy, Nazareth College, Rochester, NY

PURPOSE/HYPOTHESIS: Prior work suggests lumbopelvic motion (LPM) displayed during active hip lateral rotation (HLR) is important in people with low back pain (LBP). Clinically, LPM displayed during active HLR appears to be related to LPM displayed during passive HLR. The purpose of the current study was to examine the relationship between LPM displayed during active and passive HLR. We hypothesized that LPM displayed during active HLR would be related to LPM displayed during passive HLR. We also examined the relationship between LPM displayed during active HLR and a number of other variables that could be related to active HLR.

NUMBER OF SUBJECTS: The sample included 15 people with LBP (mean age, 28.1; 7 men, 8 women) and 20 people without LBP (mean age, 26.5; 10 men, 10 women).

MATERIALS/METHODS: Subjects completed a number of clinical tests and self-report surveys. Kinematic data were collected using a 3-D motion capture system while active and passive HLR in prone were performed. The variable used to characterize LPM during HLR was the amount of LPM completed prior to the start of LPM. Bivariate correlations were calculated to examine relationships between the amount of active HLR completed prior to the start of LPM and (1) the amount of passive HLR completed prior to the start of LPM and (2) a number of subject characteristics and clinic or laboratory findings that could be related to active HLR. Variables that were significantly (P<.05) correlated were entered into a hierarchical multiple regression analysis.

RESULTS: People with LBP: Only 2 variables were significantly correlated with the amount of active HLR completed prior to the start of LPM: (1) the amount of passive HLR completed prior to the start of LPM (r = 0.834, P<.001) and (2) gender (r = 0.786, P<.001). The amount of passive HLR completed prior to the start of LPM explained 69.5% (P<.001) of the variance in the amount of active HLR completed prior to the start of LPM. Gender explained an additional 9.7% (P = .036) of the variance in the amount of active HLR completed prior to the start of LPM. People without LBP: There were no significant correlations between the amount of active HLR completed prior to the start of LPM and any of the variables (<.04, P>.05 for all correlations).

CONCLUSIONS: The current findings suggest that (1) the amount of passive HLR completed prior to the start of LPM and (2) gender significantly predict the amount of active HLR completed prior to the start of LPM in people with LBP, but not people without LBP.

CLINICAL RELEVANCE: The findings of the current study suggest that characteristics of the movement system evident during a passive limb movement may be related to the LPM displayed by people with LBP during an
active limb movement. These characteristics may contribute to the persistent and recurrent course of LBP and, thus, are important to consider in intervention.

**OP02153**

**EVALUATION, DIAGNOSIS, AND TREATMENT OF A PATIENT WITH LOW BACK PAIN USING THE MOVEMENT SYSTEM IMPAIRMENTS APPROACH: A CASE STUDY**

**Sinish E**

**Arizona OrthoSports Physical Therapy, Phoenix, AZ**

**BACKGROUND AND PURPOSE:** The purpose of this case report is to describe the use of the Movement System Impairments approach to evaluate, diagnose and treat a patient with low back pain.

**CASE DESCRIPTION:** The patient is a 44-year old male with low back pain that radiated into the left posterior thigh to his knee. He also reported intermittent tingling in the left posterior thigh. His symptoms began 1 year prior to the evaluation with an insidious onset. His pain was intermittent and rated 5/10 on average and 8/10 at worst. He was unable to sit more than 15 minutes and could not bend forward to work on his car due to pain. He was able to stand and walk without pain. The patient worked at a desk job and was occasionally required to lift up to 50 lb. During the evaluation, his low back and posterior thigh tingling were reproduced with forward bending and with positions that flexed his spine. Extending his spine abolished the tingling. His low back pain also increased with lumbar rotation. He demonstrated accessory lumbo-pelvic rotation with lower extremity movements which increased his back pain. He was able to decrease this rotation and decrease his pain when instructed to contract his lower abdominals. Following the evaluation, the patient was given a diagnosis of Lumbar Flexion-Rotation Syndrome since flexion and rotation reproduced his pain and extension decreased his symptoms. The patient was taught to abolish the radicular symptoms by extending his spine. Following abolishment of the radicular symptoms, he was instructed in an exercise program that was designed to correct the movement faults of lumbar flexion and rotation. Exercises included lower abdominal strengthening, prone hip extension, supine and standing shoulder flexion, and use of an elliptical machine. He was educated in proper body mechanics for lifting. The patient was instructed in corrected forward bending to increase flexion in his hips and prevent excessive flexion in his spine. The patient was also educated in preventing flexion and rotational movement faults in his lumbar spine with daily activities.

**OUTCOMES:** The patient was seen for 14 visits over the span of 8 weeks. At the time of discharge, he was able to sit for 1 hour, lift and carry 50 lb, and run without back pain or radicular symptoms. The Oswestry low back index score decreased from 36 at the initial visit to 8 at the time of discharge.

**DISCUSSION:** The Movement System Impairments approach was used to evaluate a patient with low back pain. Following the MSK evaluation, movement faults were identified that reproduced the patient's symptoms. Correction of the movement faults decreased his pain. The movement faults were used to determine a diagnosis and the results of this systematic evaluation were used to design a specific exercise program focusing on correcting his movement faults to abolish his pain. The Movement System Impairments approach was used to successfully evaluate and treat a patient with low back pain.

**OP02154**

**EFFECTS OF AN EVIDENCE BASED EDUCATION PROGRAM FOR INDIVIDUALS WITH CHRONIC LOW BACK PAIN**

**Walsh EC, Boyle KL**

**Physical Therapy, Foothills Sports Medicine, Phoenix, AZ; Physical Therapy, Northern Arizona University, Flagstaff, AZ**

**PURPOSE/HYPOTHESIS:** The purpose of this study is to analyze the effects of participation in an evidence-based “Back Education Program” in addition to physical therapy (PT) treatment for chronic low back pain (LBP). We hypothesize that the participants in an evidence-based Back Education Program will maintain or improve functional level as measured by the Oswestry Disability Index (ODI) 6 months following discharge from PT.

**NUMBER OF SUBJECTS:** Eight subjects have completed PT treatment along with the Back Education Program, 5 females and 3 males. Included in the study are any patients who report LBP lasting longer than 3 months or more than 1 episode in the past year, from age 18 to 70. The average age is 43 with a range of 22 to 62. The intention of this study is to collect data on 50 participants in the Back Education Program.

**MATERIALS/METHODS:** Participating subjects will be recruited from a privately-owned PT clinic. The subjects complete the ODI at the beginning of their treatment and at discharge. Then a follow-up ODI will be mailed to them at 6 months following discharge. The participants in the “Back Education Program” receive PT in addition to regular 15- to 30-minute intervals with the primary investigator for the “Back Education Program.” The neurophysiology of pain is discussed. Postural adaptations to decrease pain and improve spine health in sitting, standing and sleeping are demonstrated and practiced by the subject. Bending and lifting techniques to protect the spine are demonstrated and practiced by the subject. A home exercise program of general spinal stabilization exercises is discussed and demonstrated.

**RESULTS:** The ODI scores were taken on the initial and discharge visits and the change scores were then analyzed for a percentage reduction in disability. Seven subjects improved their functional level as measured by the ODI by 8% to 40%, with an average of 18.76%. One subject had no change (0%).

**CONCLUSIONS:** The majority of this small sample have had positive results with the Back Education Program in addition to PT.
positioned at 20° flexion from the horizontal plane. A pair of testers performed imaging acquisition. One tester was responsible for locating cervical multifidi and giving commands to the participants while the other was responsible for imaging capture and on-screen measurement of muscle thickness. To determine intrater reliability, the pair performed 2 measurement sessions on the same day with a 30-minute rest in between. The tester first indentified the spinous processes of C4-C7 with palpation and then marked with a felt pencil. A curvilinear transducer (2-5 MHz) was placed longitudinally along the mid-lower cervical spine (C4-C7) and then moved laterally until the zygapophyseal joint could be identified. The parasagittal images were taken at rest and then during the "chin-tuck and head lift" maneuver on both right and left sides. The muscle thickness for each segment (C4-7) was determined with linear measurement from the tip of the target zygapophyseal joint to the inside edge of the posterior border of the CM.

RESULTS: With chin-tuck and head-lift maneuver, muscle thickness of the CM increased 3% to 8% on the right C4-7, and 3% to 7% on the left C4-7. The intraclasse correlation coefficients (ICC) showed poor to good reliability at rest with ICCr being 0.88, 0.77, 0.52 and 0.36 for the right C4 to C7 respectively, and 0.85, 0.71, 0.51 and 0.36 for the left C4 to C7 respectively. The ICC showed good reliability during contraction with ICCc being 0.74, 0.75, 0.72 and 0.60 for the right C4 to C7 respectively, and 0.85, 0.71, 0.71 and 0.79 for the left C4 to C7 respectively.

CONCLUSIONS: The results showed that the CM muscle thickness increased during chin-tuck and head-lift maneuver at C4-C7 segments using the RUSI para-sagittal imaging method. The reliability was better during contraction possibly because the muscle boundary was easier to identify when the zygapophyseal joints and muscle fascia moved.

CLINICAL RELEVANCE: The para-sagittal imaging may be a useful noninvasive method to study CM muscle function at multiple cervical segments at the same time in patients with neck pain and to investigate effectiveness of physical therapy interventions on the CM muscle.

OP02156

IMMEDIATE EFFECT OF USING AN ANTERIOR TO POSTERIOR CERVICAL MOBILIZATION TECHNIQUE IN A PATIENT WHO MET THE CLINICAL PREDICTION RULE FOR CERVICAL RADICULOPATHY

Yung E
Orthopaedic Physical Therapy Residency Program, Kaiser Permanente West Los Angeles, Los Angeles, CA

BACKGROUND AND PURPOSE: There is no primary literature report indicating the use of anterior-posterior mobilization for the treatment of cervical radiculopathy. Therefore, the purpose of this case is to present the initial effect of using this procedure in a patient who met the clinical prediction rule for cervical radiculopathy.

CASE DESCRIPTION: A 35-year-old female presented with reports of insidious onset radiating left sided neck and scapular pain (P1). She was evaluated 2 months later and her initial findings were: Neck Disability Index was 36%, Shoulder Pain and Disability Index was 54.6%, Numerical Pain Rating Scale was 5/10, Fear-Avoidance Belief Questionnaire for Physical Activity 11 and for Work 10. Active Range of Motion (ROM) of the cervical spine in all planes was measured. Spurling’s, manual cervical distraction, and upper limb tension test for median nerve (ULTT A) were tested. The clinical measures of this patient met all 6 of the clinical prediction rule for cervical radiculopathy. Passive accessory intervertebral motion testing directed anterior to posterior reproduced P1 at C6 on the left side. Following the examination procedures and prior to treatment, measurements were made pretreatment and posttreatment that day. Vital signs were recorded as well. Therapy consisted only of cervical spine mobilization using anterior to posterior glides (2 sets of 6 bouts, 10 seconds per bout); no other intervention was provided.

OUTCOMES: AROM revealed improvement of cervical spine extension from 18° to 30°; rotation to right from 18° to 48°, to left from 30° to 45°; ULTT A also improved from P1 at 66° of shoulder external rotation to P1 at 40° of elbow flexion. Global rating of change was 70% reduction of P1. Vital sign profile was stable when compared preintervention and postintervention. No adverse effects were reported such as dizziness, headache, nausea, or vomiting.

DISCUSSION: The initial effect of using anterior-posterior mobilization of the cervical spine resulted in dramatic reduction of pain, and improved clinical parameters. The above preliminary results are intriguing but conclusions cannot be made regarding the cause and effect relationship using this manual therapy technique.
Frequent and prolonged computer use, prolonged static muscle contraction, and extreme working postures have been associated with an increased risk of neck pain in the workplace. The purpose of this case series was to describe the immediate and long-term outcomes of stress management as an adjunct to standard physical therapy intervention for chronic neck pain among 4 female office workers.

**CASE DESCRIPTION:** Four patients (aged 44-57 years) with a history of chronic neck pain (3-8 years duration) participated in this case series. All patients were employed full-time, reported spending more than half of their typical workday at the computer, and exhibited an increase in trapezius muscle activity in response to psychosocial stress during simulated work tasks prior to treatment. Two of the 4 patients had previously participated in physical therapy with only temporary relief of symptoms. Patients participated in 4 weeks of standard physical therapy management and 4 weeks of stress management. The physical therapy intervention consisted of patient education, therapeutic exercise, posture and movement training, aerobic exercise, manual therapy, and modalities. During the stress management intervention, patients were instructed in mindfulness, guided imagery, diaphragmatic breathing, and cognitive behavioral techniques in 4 psychotherapy sessions. Patients also performed simulated work tasks while receiving auditory, verbal, and manual cues to minimize trapezius muscle activity in 4 biofeedback sessions.

**OUTCOMES:** All subjects reported improvements in neck disability, anxiety levels, and overall mental and physical health perception immediately following treatment. Objective physical impairment measures also improved, including a reduced sensitivity to mechanical pressure for all patients, improved cervical range of motion, and improved scapular muscle strength for 3 out of 4 patients. Most patients demonstrated improved habitual patterns of muscle activity in the workplace, including decreased static muscle activity and increased frequency of muscular rest throughout the workday. Although patients demonstrated only partial retention of these improvements at the 3 month follow-up, clinical outcomes remained improved relative to baseline. Similar patterns of change in trait anxiety and static muscle activity in the workplace were observed across time for 3 patients.

**DISCUSSION:** Subjective and objective outcomes improved following a multidisciplinary intervention that combined physical therapy with stress management techniques for 4 female office workers with a history of chronic neck pain who exhibited elevated muscle activity in response to stress prior to treatment. Future research will investigate the effectiveness of this intervention in stress-responsive patients, as well as strategies to improve long-term retention of immediate outcomes.

**OP02160**

**ANALYSIS OF CLINICIAN USE OF 5-POSITION GRIP STRENGTH DYNAMOMETRY: A NATIONAL SURVEY**

**Phillips IH, Irish D, Kristin K, Kristi M, Hinal S**

Dept of Physical Therapy, Seton Hall University, S Orange, NJ

**PURPOSE/HYPOTHESIS:** The purpose of this study was to survey Physical Therapists (PTs) and Occupational Therapists (OTs) about their utilization and interpretation of 5-position grip strength testing to determine sincerity of effort, and to compare their responses to current best evidence. The survey determined how clinicians are administering the test, what protocol they prefer to use, and how the results are interpreted. It is hypothesized that there is a lack of awareness of current best evidence for administration and interpretation of 5-position grip strength testing for sincerity of effort.

**NUMBER OF SUBJECTS:** 400 clinicians nationwide who were licensed physical or occupational therapists were invited to participate. There were 76 respondents (19% response rate,) with each of the 4 major geographic regions of the U.S. represented. There were 32 Physical Therapists and 44 Occupational Therapists, 49 of whom (64%) were Certified Hand Therapists (CHT). Average clinician experience was 18.65 (+2.43) years of clinical practice. Of those responding, 56 indicated that they employed 5-position hand dynamometry, and this figure was used for all descriptive statistics.

**MATERIALS/METHODS:** Clinicians were invited to participate via e-mail correspondence with a link to an on-line survey. The survey consisted of 22 questions, including clinician demographics, test administration, and results analyses. Questions were in the form of multiple choice and open ended queries. All survey responses were completely confidential. Results were analyzed using simple descriptive statistics.

**RESULTS:** Regarding grip strength procedures and protocols, 29 (52%) of respondents indicated that they follow the American Society of Hand Therapists (ASHT) positional guidelines, while all 56 (100%) attempted to standardize posture and arm position. There was also good consensus regarding expectations for force output when considering age, gender, and handedness. Areas in which greater clinician variability was seen in-
Wolff-Parkinson-White syndrome (WPWS)

Male and female patients between the ages of 18

This preliminary study provides valuable informa

- Clinical Relevance: Clinicians administering 5-position hand dynamometry may need to review their interpretation practices to better match current best evidence. Further research is needed on standardizing the protocol for interpretation of 5-position hand dynamometry to ensure consistent and accurate use of this assessment tool.

**OP02161**

**COMPARISON OF THE BEHAVIORALLY ANCHORED LIFT TASK EVALUATION (BALTE) TO WADDELL’S NONORGANIC SIGNS AND/OR FIVE-POSITION GRIP STRENGTH TESTING: A RETROSPECTIVE - CHART REVIEW**

*Phillips HJ, Oyesile A, Petrolis K, Schulman I, Yun C*

Department of Physical Therapy, Seton Hall University, South Orange, NJ

**Purpose/Hypothesis:** The BALTE is a newly developed lift task evaluation system that assesses sincerity of effort and pain reporting, and is intended to be used as part of a Functional Capacity Evaluation (FCE). The BALTE was shown to be reliable in a previous study, however comparison to other tests of effort and pain behaviors has not been done. This study compares the BALTE with the established methods of Waddell’s nonorganic signs and the 5-position grip strength test. It is hypothesized that persons who score positively with the BALTE will also score positively with the Waddell’s nonorganic signs and the 5-position grip strength test.

**Number of Subjects:** Male and female patients between the ages of 18 and 65 referred to a single work hardening center from January 1, 2005 to December 31, 2005 for an FCE, with work-related back or upper extremity impairment and functional limitation.

**Materials/Methods:** A retrospective chart review of 200 patients that performed the BALTE, and/or Waddell’s nonorganic signs and 5-position grip strength testing as part of an FCE was conducted. Waddell’s testing was considered positive if 3 or more categories were judged positive, while 5-position grip strength testing was considered positive if standard deviation between positions was 8.5, or less. Two x 2 contingency tables matching results of the BALTE and Waddell’s or BALTE and 5-Position grip strength testing were created. A phi coefficient was calculated using SPSS 15.0 for analysis of data.

**Results:** Phi coefficient revealed a significant correlation between BALTE and Waddell’s nonorganic signs (phi, 0.752; P<.001) but not between BALTE and 5-position grip strength testing.

**Conclusions:** The BALTE is purported to assist practitioners in determining sincerity of effort and symptom reporting during lift task evaluations. Therefore, it was hypothesized that results would correlate with Waddell’s nonorganic signs and 5-position grip strength testing, both of which are commonly used to assess patient function. The BALTE correlated with Waddell’s nonorganic signs, but not 5-position grip strength testing.

**Clinical Relevance:** The BALTE may be a more valid tool for judging sincerity of effort and pain reporting related to the low back than for problems of the upper extremity.

**OP02162**

**PARTIAL BODY WEIGHT SUPPORT DURING THE SIT-TO-STAND MOVEMENT DECREASES VERTICAL GROUND REACTION FORCE AND MUSCLE ACTIVITY IN HEALTHY YOUNG ADULTS**

*Ballantyne B*

Physical Therapy Department, St. Ambrose University, Davenport, IA

**Purpose/Hypothesis:** The purpose of this study was to examine the effect of partial body weight support (BWS) on peak vertical ground reaction force (pkVGRF) and muscle activity during the sit-to-stand (STS) movement. It was hypothesized that providing partial BWS during STS transfers would significantly decrease pkVGRF and muscle activity, particularly of the hip and knee extensors.

**Number of Subjects:** Twenty adult females (mean age, 22.1 ± 1.0 years).

**Materials/Methods:** Subjects were seated on a bench with their back and thighs unsupported. Seat height was adjusted to equal the distance from the knee joint line to the floor. Partial BWS was provided by elastic cables attached to both sides of a harness secured around the subject’s waist and thighs. When seated, the elastic cables were stretched to approximately 130% of their resting length to provide an upwardly-directed pulling force that assisted subjects in rising to a standing position. Once in the standing position, the cables were at their resting length. Three levels of assistance (No Assist, Low Assist, High Assist) were tested in each subject determined by the number of elastic cables (0, 1, or 2) attached to each side of the harness. The order of presentation of assistance level was randomized for each subject. Subjects were instructed to rise from a seated to a standing position at a self-selected speed with arms folded across the chest. Five trials were performed at each level of assistance. A force platform was used to measure VGRF during completion of each STS task. Load cells placed in series with the elastic cables monitored the actual lifting force throughout the movement. Tension on the cables at the time of pkVGRF was used to quantify assistance force. EMG was used to record muscle activity from gluteus maximus (GM), vastus lateralis (VL), medial hamstrings (MH), tibialis anterior (TA), and medial gastrocnemius (MG). Other dependent variables included pkVGRF expressed as percent body weight (%BW), normalized integrated EMG just prior to pkVGRF, movement time, and time to pkVGRF. Data were analyzed using repeated measures analyses of variance.

**Results:** On average, partial BWS decreased pkVGRF by 21.0%BW (P<.001) with Low Assist and by 37.4%BW (P<.001) with High Assist. Compared to trials without BWS, Low Assist decreased muscle activity by 13.7%, 30.3%, and 36.2% (P<.001) for GM, VL, and TA, respectively. High Assist decreased muscle activity by 27.8%, 47.3%, and 56.1% (P<.001) for GM, VL, and TA, respectively. Muscle activity of MH and MG did not change with partial BWS. Movement time and time to pkVGRF were also not affected by partial BWS.

**Conclusions:** Partial BWS during STS transfers significantly decreases VGRF and reduces the demand for lower extremity muscle activity. **Clinical Relevance:** This preliminary study provides valuable information for planning future studies in which partial BWS could be used to design training programs for mobility-impaired persons to improve or regain their ability to rise from a chair independently.
A 14-years-old gelded male horse, used for pleasure riding, presented with 3 year insidious regression of periodic episodes of lameness with increased incidence of crepitus at stifles, stumbling, and multiple episodes of the horse's bilateral hind limbs locking up causing his hind end to collapse while riding. Collapsing occurs when the stifle and hock are fixed in extension, while the digital joints are held in flexion with the toe dragging as the horse tries to move forward. Upon walking this horse in a straight line, he would exhibit consistent crepitus 12 strides out of measured 15 strides. The horse was diagnosed with IUFP by 2 consulting veterinarians. Physical therapy intervention consisted of educating the owner regarding the stifle patho-mechanics, stretching exercises of hind-end musculature, isometric exercises of tensor fascia lata, quadriceps and biceps femoris muscle complex, progression of isotonic strength training of the quadriceps and hamstrings. The measurable goal of crepitus reduction occurrence of 2 or less times over 8 weeks. The patella becomes stuck on the medial femoral condyle, preventing flexion of the joint, resulting in pain, swelling, and reduced functional locomotion. This case report describes rehabilitation protocol for IUFP.

CONCLUSIONS: Previous research notes that routine examination of VS and general survey measures is not a common practice among physical therapists. This study found that CE coursework in differential diagnosis positively effects the inclusion of some VS measures as routine components of initial patient examination.

CLINICAL RELEVANCE: Due to a small sample size, it is difficult to generalize these findings. Continuing education in differential diagnosis may have a positive influence on physical therapists’ decisions to include vital signs and general survey measures in their initial examination of adult clients.

A SURVEY OF PHYSICAL THERAPISTS’ INITIAL EXAMINATION SCREENING OF GENERAL SURVEY AND VITAL SIGN MEASURES

Bertram S, Tirtianto W, Fernandez D

Department of Physical Therapy and Health Science, Bradley University, Peoria, IL

PURPOSE/HYPOTHESIS: Physical therapists see consumers for the diagnosis of disabilities related to movement, function and health. Screening measures such as general survey and vital signs (VS) help provide the PT information necessary to formulate an appropriate intervention plan. It was hypothesized that the level of entry-level physical therapy education and the amount of continuing education in differential diagnosis would positively influence their decision to collect these data during an initial patient examination.

NUMBER OF SUBJECTS: Fifty six randomly selected physical therapists that were members of the Illinois Physical Therapy Association participated in an online survey.

MATERIALS/METHODS: This study investigated via an online survey the frequency that physical therapists conducted general survey (height and weight) and vital sign measures (pulse, blood pressure [BP], respiratory rate [RR], temperature), and whether the level of entry-level PT degree or continuing education (CE) in differential diagnosis influenced their decisions. The frequency of general survey and vital signs measurement and demographic and educational information was analyzed.

RESULTS: Forty percent of respondents obtained an entry level graduate degree (master’s or doctoral) in PT and the majority (53%) completed CE coursework in differential diagnosis. Despite their exposure to differential diagnosis the majority of respondents did not routinely assess vital signs. Independent t tests conducted revealed no differences based on level of degree. When examining the responses of PTs that treated adults only, CE influenced assessment of general survey measures and vital signs. The completion of CE coursework in differential diagnosis improved the likelihood that a PT would assess vital signs overall, specifically pulse, BP and RR.
C O M B I N E D   S E C T I O N S   M E E T I N G

North Chicago, IL

BACKGROUND AND PURPOSE: As the physical therapy profession moves toward autonomous practice, the physical therapist must demonstrate the ability to perform differential diagnosis of musculoskeletal conditions. Currently, clinicians typically rely on clinical measures to arrive at a musculoskeletal diagnosis. In this case, the ability of the physical therapist to order plain film imaging assisted in the differential diagnosis of a patient presenting with anterior hip pain.

CASE DESCRIPTION: A 20-year-old male Navy recruit reported to the Recruit Training Command Physical Therapy Clinic at Naval Station Great Lakes, IL via direct access for musculoskeletal screening by a physical therapist. He had complaints of “deep” left anterior hip pain for 10 days that was gradual in onset. He denied recent trauma and any pain prior to entering basic training. The patient reported he had been physically active prior to entry and activities included high school varsity football and basketball. At initial evaluation, he reported a 6/10 pain level and noted tenderness to deep palpation over his left anterior hip. Physical examination revealed full left hip active/passive range of motion with pain noted at all end range movements and manual muscle test strengths of 4/5 with pain for all left hip motions. Special tests were unable to isolate specific pathology due to easily elicited pain with all testing. As a result of the provocation of pain on all exam procedures, a plain film radiograph was ordered by the physical therapist. The plain film radiograph of the hip revealed a large expansive bony lytic lesion to the left proximal femur with cortical thinning.

OUTCOMES: After discussion of the case with an orthopedic surgeon, the patient was placed on strict non-weight-bearing gait and immediately referred to orthopedic surgery. Confirmation by magnetic resonance imaging (MRI) and biopsy noted an Aneurysmal Bone Cyst (ABC). Surgical treatment consisted of curettage and bone grafting using a cancellous iliac bone graft. Following surgery, the patient was seen in the Physical Therapy Department for the remainder of his rehabilitation. He was eventually medically discharged from the Navy, and has since returned to full physical function and has had no known complications following the surgery or rehabilitation to this date.

DISCUSSION: This case demonstrates that excellence in differential diagnosis for a physical therapist practicing in the primary care setting may require the ability to order and use various diagnostic tests, including plain film radiographs, to properly assess the patient. The military has practiced under this type of direct access model for over 30 years and physical therapists have demonstrated its effectiveness. In addition, the ability of the physical therapist to order diagnostic tests may result in a more efficient and cost-effective neuromusculoskeletal primary care model.

SUBJECTIVE RESPONSES TO A REPEATED MAXIMAL EXERCISE TEST PARADIGM IN INDIVIDUALS WITH CHRONIC FATIGUE SYNDROME AND NONDISABLED INDIVIDUALS


Department of Physical Therapy, University of the Pacific, Stockton, CA; Department of Sports Sciences, University of the Pacific, Stockton, CA; Whittemore Peterson Institute for Neuro-Immune Disease, Reno, NV

PURPOSE/HYPOTHESIS: Chronic fatigue syndrome (CFS) is an increasingly common health condition in orthopaedic physical therapy settings, which is characterized by postexertional malaise (PEM). To date, limited information exists to characterize the subjective experience of PEM individuals with CFS. The purpose of this study was to document symptoms and perception of health status in response to a test-retest maximal exercise paradigm in individuals with and without CFS.

NUMBER OF SUBJECTS: Individuals with CFS (n = 15, 15 women) and sedentary individuals matched for age and sex (n = 17, 17 women) participated in this study.

MATERIALS/METHODS: All subjects received an exercise challenge consisting of 2 maximal bicycle ergometry exercise tests within 24 hours. The Short Form 36 (SF-36) was administered before and 7 days following the exercise challenge. An open-ended symptom questionnaire was administered before and after each exercise bout, and 7 days after the repeated exercise challenge. Statistical significance of between-groups differences in SF-36 subscale scores and self-reported time to recover was assessed with t tests. Frequencies of self-reported symptoms during recovery were documented between groups and expressed as a percentage of total observations. Alpha level was set at .05 for statistical significance.

RESULTS: SF-36 subscale scores were significantly different after exercise challenge between groups for all subscales except health transition (P < .05). All subjects without CFS reported recovery within 1 day (mean ± standard deviation: 0.20 ± 0.41 days). In subjects without CFS, 3 reports of symptoms were documented, including fatigue (2.2%), pain (2.2%), and muscular discomfort (2.2%). Self-reported absence of symptoms accounted for 93.3% of observations at 7-day follow-up in individuals without CFS. Among individuals with CFS who reported recovery within 6 days (60%), mean self-reported time to recover from the exercise challenge was 4.9 ± 1.8 days. Six individuals with CFS (40%) reported recovery took greater than 7 days. A total of 38 reports of symptoms were observed in individuals with CFS at 7-day follow-up, including fatigue (26.3%), pain (15.7%), muscular discomfort (13.1%), orthostatic intolerance (18.4%), illness (15.7%), sleep disturbance (5.3%), and other symptoms (5.3%). No individuals with CFS reported an absence of symptoms at 7 days following exercise challenge.

CONCLUSIONS: Individuals with CFS in this controlled study reported a greater frequency and broader range of symptoms during a longer recovery period from physical activity than individuals without CFS, which is consistent with published anecdotal descriptions of PEM.

CLINICAL RELEVANCE: This study elucidates clinically important differences in the subjective symptom experience of recovery from exercise in otherwise nondisabled sedentary individuals and individuals with CFS who demonstrate PEM.

COMPARING BILATERAL MOTION IN ASYMPTOMATIC SUBJECTS DURING UPPER EXTREMITY NERVE TENSION TESTING

Dronberger J, Foley A, Sturgill W

Physical Therapy Education, Rockhurst University, Kansas City, MO

PURPOSE/HYPOTHESIS: Comparing motion between paired extremities is one parameter used by clinicians when performing neural tension testing for nerve entrapments. Existing protocols for neural testing include a presumption that symmetrical motion may indicate the absence of entrapment. The purpose of this study was to determine if asymptomatic subjects demonstrate symmetrical motion during 3 upper extremity neural tension tests.

NUMBER OF SUBJECTS: 61 subjects met inclusion criteria for 2 or more of the 3 tests performed. The range of age was 18 to 66 years. A minimum of 58 subjects was included for any single test.

MATERIALS/METHODS: Each subject was positioned on a treatment table covered by a pegboard, which was used to align subjects and to guide passive motion during testing. The same table and board were used for all tests. One examiner moved the tested limb to the subject’s comfortable and/or available end range position in accordance with 3 upper extremity peripheral nerve tension tests (ie for median, radial, and ulnar nerves) in the same order. A second examiner measured the achieved end range position using a 12” goniometer, which was used for all tests. This measurement procedure was repeated on the paired extremity for each test.

RESULTS: Findings indicated there were no statistically significant differences (P < .05) between right and left upper extremity range of motion during nerve tension testing. For each test, the final step of upper extremity motion was achieved in 98% of subjects, who reported minimal to no neural symptoms. Median and ulnar nerve tension testing results
showed right upper extremity end range was greater than left by 2.37° and 0.89°, respectively. Radial nerve tension testing results showed left upper extremity end range was greater than right by 0.49°. Neither hand-edness nor gender had a statistically significant influence on end range of motion or symmetry of end range of motion in any of upper extremity nerve tension tests included in this study.

CONCLUSIONS: These findings suggest that asymptomatic individuals able to reach end range positions during upper extremity nerve tension testing exhibit symmetrical motion.

CLINICAL RELEVANCE: Physical therapists may expect to find symmetrical motion during upper extremity nerve tension testing in subjects who do not present with signs of neural entrapment. These findings may help to rule out, or rule in, the presence of neural entrapment.

**OP02169**

**EFFECT OF AN INPATIENT REHABILITATION PROGRAM ON THE GAIT OF PATIENTS WITH NEW TRANSTIBIAL (TTA) AND TRANSFEMORAL (TFA) AMPUTATIONS**

Gorrell C, Lucas M, Beecher N, Esquenazi A
Moss Rehab, Elkins Park, PA

PURPOSE/HYPOTHESIS: To determine if an inpatient acute rehabilitation program will increase the speed of ambulation, reduce the base of support, increase prosthetic single limb stance, and improve symmetry of step length and stance in subjects receiving training with their initial prosthesis.

NUMBER OF SUBJECTS: 34 Subjects with mean age of 60.5 years (range, 36-93 years) transtibial (22) and transfemoral (12) amputations admitted for acute inpatient rehabilitation at a regional amputee center.

MATERIALS/METHODS: All subjects were training with their initial prosthetic limb and included both dysvascular and traumatic amputations. Measurements of gait kinematics were taken within the first 3 days of admission and again within 1 day of discharge. Interventions: All subjects received 2 hours of physical therapy, 1 hour of occupational therapy, and 1 hour of amputee specific education daily. They also received prosthetic adjustments as needed. Outcome Measures: Velocity, base of support (BOS), prosthetic single limb stance (SLS), symmetry of stance, and symmetry of step length.

RESULTS: The average length of stay was 11.5 days ranging from 5-21 days. Across all diagnoses the velocity increased by 53.3%, BOS decreased by 5.76%, prosthetic SLS increased by 27.8%, step length symmetry increased by 21.1%, and stance symmetry increased by 18.6%. However, not all improvements were noted within each diagnosis. For subject with transfemoral amputations (TFA) the increase in velocity (P = .000006), increase in prosthetic SLS (P = .000009), and increase in symmetry of step length (P = .047) were significant. Although statistical power was limited, there was a statistical trend toward improvement in symmetry of step length (P = .11), but no change in base of support. The Transfemoral (TFA) group had no statistically significant changes, although trends were noted for increased velocity (P = .06) and increased prosthetic SLS (P = .13) however no other trends occurred.

CONCLUSIONS: This study demonstrates that inpatient rehabilitation improves the gait of subjects with TTA who are training with their initial prostheses in regard to velocity, prosthetic SLS, and symmetry of step length. While subjects with TFA did not demonstrate statistically significant changes, trends of improvement were noted in several areas. There was a noted decline in symmetry of gait for transfemorals. We feel that these declines are potentially due to compensatory mechanisms used to increase velocity in this group and hope to address this issue in future studies. Additionally our study reinforces the greater difficulty in ambulation for patient with higher levels of amputation. More subjects are needed to determine statistical difference in the TFA populations.

CLINICAL RELEVANCE: Velocity and BOS have been correlated with function while Single limb stance and symmetry have been reported to relate energy conservation and preserve the intact limb. There are no current studies related to function with the phase of prosthetic training.
CONCLUSIONS: The neural provocation test for the median nerve (NPTm) on F-wave response (latencies).

PURPOSE/HYPOTHESIS: To determine the effects of the neural provocation test for the median nerve (NPTm) on F-wave response (latencies).

NUMBER OF SUBJECTS: 39 participants were initially screened bilaterally using the NPTm as described by Butler. The mean age was 23 ± 1.8 years. There were 12 male subjects and 27 female subjects. Following the screenings, 2 subjects were excluded from the study because they had negative neural tension tests. Three subjects had positive results in 1 extremity. This resulted in a total n = 71.

MATERIALS/METHODS: The F-wave response was assessed in subjects with positive NPTs of the median nerve. Two test positions were utilized: the position of symptom onset during the NPTm and the standard position for performing nerve conduction studies. Subjects were assigned to groups based on the order of testing to rule out any order effects.

RESULTS: F-wave latency differed significantly based on test position (P<.001). Pairwise comparisons indicated that F-wave latency during the NPTm was longer than F-wave latency in the standard position (0.766 ms; 95% CI: 0.355, 1.177).

CONCLUSIONS: This study appears to support the use of results from the neural provocation test in drawing inferences related to adverse neural tension, adding to the evidence for validity. The large association (ω/Y/A. BL = .155) and effect size (f = .539) combined with the difference in F-wave latencies seems to indicate that symptoms associated with a positive NPTm are related to neural involvement.

CLINICAL RELEVANCE: Therapists can be confident that positive results using the NPTm indicate some level of neural involvement.

AN ASSESSMENT OF ISOKINETIC TRUNK STRENGTH AND ROTATION RANGE OF MOTION IN COLLEGIATE FOOTBALL PLAYERS

Rabel MC, Olds G, Acap R, Eller A

Physical Therapy, University of Maryland Eastern Shore, Princess Anne, MD

PURPOSE/HYPOTHESIS: Information on the strength characteristics of the trunk as well as the relationships between strength and range of motion (ROM) in football players is limited. The aims of this study were to: (1) evaluate the concentric isokinetic trunk profile for Division III collegiate football players using a semi-standing protocol; and (2) determine the relationships between trunk strength and rotation ROM in the same players.

NUMBER OF SUBJECTS: Forty-one Division III collegiate football players (mean age ± SD, 19.4 ± 1.3 years; range, 18-23 years) completed all measures in the study. Each subject was tested for trunk rotation passive range of motion and isokinetic concentric flexion/extension strength.

MATERIALS/METHODS: Trunk extension and flexion muscle performance were tested on a Biodex System 3 isokinetic dynamometer at 60°/s in a semi-standing position. Trunk rotation passive ROM was measured bilaterally using dual inclinometers. Subjects were placed on their side in a position similar to the semi-standing strength test. The movable in-
clinometer was positioned at the mid-axillary line, 1 finger width below the inferior angle of the scapula. The stationary inclinometer was placed on the sacrum to prevent pelvic substitution. This technique has been shown to have high test-retest reliability. A Pearson product correlation analysis, using SPSS for Windows 17.0, was used to assess for relationships between variables.

RESULTS: A significant correlation \( (r = 0.58, P < .001) \) between trunk flexion peak torque and body mass index was found. Trunk extension to flexion peak ratio was 1.92 with a mean extension/flexion peak torque of 300.7 Nm/159.2 Nm. The ICC values for intrarater reliability for trunk rotation ROM were 0.94 for left, 0.83 for right, and 0.92 for total. The standard error of measurement was found to be 1.96° for left, 3.31° for right, and 3.95° for total trunk ROM. Total trunk rotation ROM was 125.4° with a right to left rotation ratio of 1.16. Significant inverse correlations were found between trunk flexion peak torque and all rotation range of motion variables, with \( r \) values ranging from \(-0.34\) to \(-0.48\) \((P < .03)\).

CONCLUSIONS: Using inclinometers to measure trunk flexibility appears to be an important clinical assessment that can be implemented with relative ease. These data demonstrate the inverse relationship between flexibility and strength and have implications for rehabilitation and core training programs. A better understanding of the relationship between trunk strength and range of motion can assist clinicians in evaluating and training athletes who use trunk strategies to generate force.

CLINICAL RELEVANCE: Most sport skills require a combination of trunk flexion and rotation. However, trunk rotation ROM examinations are not routinely conducted prior to sport participation or core training programs.
measure of lower abdominal strength because it covers a broader range of MMT grades, especially the lower end. Clinically this method is also helpful because it can be taught as a progressive exercise as part of the patient’s home program.

OP02177

COMBINING THE REGIONAL INTERDEPENDENCE MODEL WITH THE WHO-ICF IN TREATING A PATIENT WITH SHOULDER PAIN

Terpsstra C, Maher E, Schaar C

Carroll University, Waukesha, WI

BACKGROUND AND PURPOSE: The International Classification of Functioning, Disability and Health (ICF) is a framework designed to establish an internationally accepted terminology for describing the impact of health conditions on the individual, described fully in previous literature. The American Physical Therapy Association adopted the ICF in June of 2008, but to be useful to physical therapists, it must completely describe their treatment approach by including secondary impairments, or impairments not directly related to the health condition that influence the impact of the condition. The Regional Interdependence Model (RIM) describes how these secondary impairments can cause or maintain the primary impairments. Recent research supports treating secondary impairments in the thoracic spine and ribs for shoulder conditions, the hip for low back and knee conditions, and the low back for knee conditions. The purpose of this case report is to demonstrate the importance of incorporating the RIM with the ICF framework to treat a patient with shoulder pain.

CASE DESCRIPTION: The patient was a 55-year-old male with left supraspinatus and infraspinatus tendonosis. Using the RIM and ICF, the therapist identified primary impairments of left shoulder pain and weakness and a secondary impairment of poor scapular mobility. These lead to the activity limitations of reaching overhead and lifting heavy objects and the participation restrictions as a tool and die maker and roommate. The secondary impairment of limited scapular abduction was hypothesized to be the primary cause of the tendonosis. Interventions focused on improving motor control of the scapula, building from isolated motions to resisted motion of the arm in whole body patterns.

OUTCOMES: After 10 visits over 5 weeks, the patient’s primary impairment of shoulder muscle weakness improved from 3/5 to 5/5. Active range of motion improved from 90° of shoulder abduction at baseline to 175°. The secondary impairment improved from 20° of scapular abduction initially to approximately 60°. The patient’s activity limitations and participation restriction improved, with the patient noting he was able to perform all work and home duties. This coincided with the Disabilities of the Arm, Shoulder, and Hand (DASH) score improving from 25% at baseline to 4.46%.

DISCUSSION: This case report helps explain the importance of incorporating the RIM with the ICF framework to treat a patient with shoulder pain. Since the therapist felt that the decreased scapular abduction caused the impingement of the rotator cuff tendons during overhead motion, identifying and treating this impairment was essential for reducing the primary impairments and preventing re-occurrence. By integrating the concept of the secondary impairment into the ICF, the framework will better describe the skills that physical therapists have to analyze movement and determine the relevance of seemingly unrelated impairments on the primary impairments, activity limitations and participation restrictions.

OP02178

RELIABILITY AND REPRODUCIBILITY OF THE GAITRITE SYSTEM IN THE MEASUREMENT OF TEMPORAL AND SPATIAL CHARACTERISTICS OF GAIT IN INDIVIDUALS WITH LOWER EXTREMITY (LE) LIMB LOSS


Physical Therapy, Touro College School of Health Sciences, Bay Shore, NY

PURPOSE/HYPOTHESIS: The purpose of the study is to determine if the GAITRite System is reliable and ensures reproducible results when measuring temporal and spatial characteristics of gait in individuals with LE limb loss.

NUMBER OF SUBJECTS: 25

MATERIALS/METHODS: A convenience sample of individuals with trans-tibial (TT) and trans-femoral (TF) amputations aged 24 to 67 were studied. Ten subjects had TF amputations and 15 had TT amputations. The subjects were recruited from a local prosthetic center, ‘A Step Ahead’, in Hicksville, NY. All of the gait parameter data were collected using the GAITRite system. The following gait characteristics were measured on both the sound side (SS) and amputated side (AS): stride length (StrL), step length (StpL), base of support (BOS), toe in/out (TI/O), velocity (VEL), and cadence (CAD). Each subject walked on the walkway for 2 trials. Test-retest reliability for GAITRite measures were established with Pearson Product-moment correlation coefficients and reproducibility was determined with 2 tailed paired t tests. In addition, TF and TT subgroup analysis was also carried out with Pearson correlation coefficients and Paired t tests in an attempt to determine if the subgroups had greater influence on reliability or reproducibility of the gait measures. Statistical significance was determined at p < .05.

RESULTS: The measurement of gait characteristics with the GAITRite System in individuals with LE limb loss demonstrated moderate reliability in 7 out of 10 gait measures as follows: SSBOS (r = .70), ASBOS (r = .75), SSTI/O (r = .79), SSStpL (r = .80), Vel (r = .80), ASStrL (r = .81), and Cad (r = .84). Three of the 10 gait measures demonstrated strong reliability with ASStpL (r = .88), ASSTI/O (r = .89) and SSStpL (r = .91). However, the results of paired t test analysis showed high reproducibility in all 10 gait measures. When subjects were separated into subgroups of individuals with TF or TT amputations, the TF group showed a greater number of gait measures (5/10) with poor to fair reliability (r = .36-.75) than individuals with TT amputations where reliability was much higher in 8/10 gait measures with the correlations ranging from r = .83 to r = .92. Reproducibility appeared to be good in both groups with little difference between individuals with TF and TT amputations.

CONCLUSIONS: The present study demonstrated moderate to strong reliability for measurements of most gait characteristics with higher reliability in individuals with transtibial amputations. Reproducibility proved to be good in all subjects with little difference between TF and TT groups.

CLINICAL RELEVANCE: Based on the present findings, clinicians can utilize the GAITRite System for the measurement of gait characteristics in individuals with LE limb loss with a reasonable degree of confidence that the gait measurements are both reliable and reproducible in this population. Therefore, the GAITRite System can be used to evaluate both efficacy and progress of rehabilitation intervention plans.
The author suggests that it may not be necessary to establish either a cause and effect or a physiological relationship between the intervention and the change being reassessed. Rather, the usefulness of a reassessment relies simply on how well the change being reassessed predicts that individual patient’s ability to achieve their goals.

**OP02180**

**THE ABILITY TO ASSESS TEMPERATURE DIFFERENCES BY PALPATION: A COMPARISON OF EXPERIENCED MANUAL THERAPISTS AND LAY INDIVIDUALS**

Levine D, Walker JR, Goulet R

Physical Therapy, University of Tennessee at Chattanooga, Chattanooga, TN; Engineering, University of Tennessee at Chattanooga, Chattanooga, TN

**PURPOSE/HYPOTHESIS:** The purpose of this study was to assess the ability of physical therapists with manual therapy experience and lay individuals with no palpation experience to determine temperature differences by palpation. The investigators hypothesized that experienced manual therapists would be able to more accurately detect temperature differences compared to lay individuals. It was also hypothesized that the differences in accuracy between the groups would become more pronounced with smaller temperature differences.

**NUMBER OF SUBJECTS:** Subjects for both the lay individuals (n = 44) and manual therapist groups (n = 44) were excluded if they had any history of hand injuries, sensory deficits, neuropathy, circulatory insufficiency, or diabetes. Lay individuals were also excluded if they had any history of palpation experience such as working in health care. Manual therapists were defined as licensed physical therapists with a minimum of 1 year of using a manual therapy approach as defined in the Guide to Physical Therapist Practice.

**MATERIALS/METHODS:** A palpation testing panel with 2 metal plates covered by chamois cloth was constructed and validated for this study. Each plate rested on an individual heating and cooling unit which was controlled by the investigators. Subjects were acclimated to the testing environment (room temperature of between 20°C-23°C) for twenty minutes and were not allowed to hold anything in their hands during this time. The 2 panels were each randomly set to a temperature between 30°C and 5°C which mimicked normal degrees of skin temperature ranging from healthy to inflamed. The pads had a 3°C, 2°C, 3°C, 4°C, or 5°C temperature difference between them. The subjects then palpated each of the 2 panels in any order with the palmar surface of their dominant hand and were given 10 seconds to decide which was warmer. The machine operator was blinded to the responses of the subjects and the recorder was blinded to the temperature differences. The randomized protocol consisted of 2 trials per subject at each temperature difference (1°C-5°C) for a total of 10 trials per subject.

**RESULTS:** Manual therapists were able to identify the warmer pad at each of the 5 temperature differences (1°C-5°C) at the P < .01 level using a Chi-square test. In comparison, lay individuals were also able to successfully detect the warmer pad at 2°C, 3°C, 4°C, and 5°C at the P < .01 level. At the 1°C comparison they were less likely to correctly identify the warmer pad (P < .02).

**CONCLUSIONS:** Both manual therapists and lay individuals were able to distinguish temperature differences of 2°C-5°C. At the 1°C temperature difference lay individuals were not as accurate as the experienced manual therapists.

**CLINICAL RELEVANCE:** Established literature has shown that skin temperature changes may occur during various pathologic conditions. Palpation may be a valid tool for screening for skin temperature changes, as data collected during this study demonstrated manual therapists could consistently detect temperature differences as subtle as 1°C.
Most tests and predictors provide effective screens for balance abilities, but some lack the ability to establish the cause of balance impairment. Healthy individuals will not have obvious balance issues; therefore, a more sensitive screening tool is needed to predict falls in healthy and older adult populations.

**Clinical Relevance:** Most tests and predictors provide effective screens for balance abilities, but some lack the ability to establish the cause of balance impairment. Healthy individuals will not have obvious balance issues; therefore, a more sensitive screening tool is needed to predict falls in healthy and older adult populations.

**OP02182**

**Physical Therapy Patient Management Within an Interdisciplinary Team in a Student-Run Outpatient Clinic**

Wyman RM, Johnson GC

Division of Physical Therapy Education, University of Nebraska Medical Center, Omaha, NE

**Background and Purpose:** The SHARING Clinic is a student-run clinic, open 1 night a week, for patients without medical insurance. Originally the clinic used only medical students, but evolved to an interdisciplinary model whose focus is to encourage collaboration, shared goal setting, and joint plan of care. In October 2008, the Continuity of Care Team (CCT) was created to promote this model. The purpose of this case report is to describe the role and benefits of incorporating physical therapy (PT) into a CCT at a student-run outpatient clinic.

**Case Description:** In October 2008, a 42-year-old Spanish speaking female was assigned to a CCT comprised of a medical student, physical therapy student (SPT), faculty physician and faculty physical therapist. Prior to this assignment, she was evaluated by student therapists on previous visits, however treatment was limited and inconsistent since PT was only available 1 night a month. Her medical conditions were extensive, and included fibromyalgia, chronic weakness in hands, edema, reports of falling and vertigo. The patient ambulated with gait deviations but no assistive device. Her primary self-reported limitation was pain and swelling in her right upper extremity (RUE) and right lower extremity (RLE). She held her RUE in a position of flexion, internal rotation, and adduction. Range of motion (ROM) of her RUE and RLE were limited due to pain and swelling. Due to the inconsistency of care, many of these conditions (including reports of falling and edema) were documented several times by different students without evidence of resolution. After the CCT examination, team goals were created to decrease her frequency of falls, increase use of RUE, and decrease edema. She was issued a single point cane for use in the community. Self-guided arm and hand ROM and was advised and she was encouraged to use her RUE as much as possible throughout the day. Compression garments were recommended to address the RLE edema. The medical student also addressed these goals in her plan of care, and reviewed the medication list for possible side effects of dizziness. On a day the SPT was not present, the medical student ordered compression garments for the patient upon recommendation by the SPT.

**Outcomes:** Within 4 months, the patient demonstrated positive improvements in all of the goals outlined by the CCT. The patient reported no falls and attributed it to her increased confidence when using the single point cane. ROM improved in her RUE and she reported increased use of her RUE in all activities of daily living. Decreased pain and edema were demonstrated in both the RUE and RLE.

**Discussion:** This interdisciplinary model has important carryover to the outpatient physical therapy setting because it teaches students how to maximize medical resources to accomplish patient goals. In this example, the patient was able to benefit from comprehensive care that resulted from effective communication and teamwork between a physical therapist student and medical student.

**OP02183**

**Ideomotor Therapy: A Case Study Describing Clinical Application and Outcomes for a Patient with Chronic Myofascial Low Back Pain**

Erickson M

Carroll University, Waukesha, WI

**Background and Purpose:** Ideomotor therapy (IT) is a manual technique used by physical therapists in clinical practice for over 30 years to facilitate expression of ideomotor activity. Ideomotor activity is nonconscious neuromuscular behavior including nonverbal communication, homeostatic or corrective functions such as yawning or postural shifting to alleviate discomfort. It is theorized that the expression of ideomotor activity alleviates mechanical pain by reducing tissue deformation serving as a pain generator. The purpose of this case study was to describe a patient with chronic low back pain who made only modest gains with several physical therapy interventions and achieved a positive outcome following implementation of IT.

**Case Description:** A multiple treatment design was used to study a 22-year-old male who presented to PT 15 months postinjury with daily LBP and substantial functional limitations. Interventions applied over 8 weeks included posture education, stretching, neural and joint mobilization and thrust, strengthening and stabilization, neuromuscular re-education for muscle recruitment imbalances, positional inhibition, and functional training. Expected outcomes were not realized and the patient was seen for an additional 6 visits over the course of 4 weeks during which IT was applied and home exercises and thrust were continued.

**Outcomes:** Following traditional PT and prior to IT, posture, ROM and joint mobility, strength, and motor control impairments were significantly reduced while only small to moderate gains in pain levels, neural mobility, tenderness to palpation, and tolerance to functional abilities were evident. Rolland-Morris LBP and Disability Questionnaire (RMDQ) score decreased from 14/24 to 9/24. The day following the initial application of IT, the subject sought out the supervising therapist to enthusiastically state he had been pain free for the first time in 17 months. After 6 sessions incorporating IT, the subject reported pain at 0/10 throughout 95% of the day, neural mobility tests were negative, and palpation was pain free. Functional abilities returned to preinjury levels and RMDQ score improved to 0/24.

**Discussion:** Current pain theory indicates myofascial pain syndromes involve central and peripheral nervous system sensitization. Movement based approaches similar to IT have been shown to alter central nervous system structure and function, decrease pain and improve function. Following application of IT, a subject with chronic myofascial LBP reported significant gains not attained after traditional PT. The favorable outcomes observed in this case are consistent with results reported previously and support the hypothesis that IT may be beneficial for facilitating therapeutic goals and for reducing the cost of chronic pain. Additional investigating appears warranted and physical therapists are uniquely positioned to lead such research which may further our societal role as evidence-based providers of choice for patients with myofascial pain syndromes.

**OP02184**

**The Development of Health and Wellness Materials Specific to the Needs of Employees of the Transportation Security Administration**

Majak M, Steffie D, Westreich B

Physical Therapy, New York Medical College, Valhalla, NY

**Purpose:** Occupational health and safety materials have been developed for employees of many types of industries and companies. However, employees of the Transportation Security Administration (TSA), who are involved in lifting, moving, and inspecting passenger baggage for extended periods of time, are an underserved population. The purpose of this project was to identify the lifting and baggage handling demands common to
CENTRAL SENSITIVITY IN A PATIENT WITH LUMBAR SPINAL STENOSIS: A CASE REPORT

Means S, Burns SA

Department of Physical Therapy, University of Colorado-Denver, Aurora, CO; Department of Physical Therapy, Temple University, Philadelphia, PA

BACKGROUND AND PURPOSE: The role of the central nervous system (CNS) in production and maintenance of pain in musculoskeletal conditions is becoming increasingly recognized. However, optimal treatment for central sensitization (CS) is unknown. As a treatment option, Moseley outlined the neurophysiology pain education with 4 points: (1) pain is not a measure of the tissue state, (2) pain is modulated by many factors from the somatic and psychosocial domains, (3) as pain persists the relationship between tissue state and pain is less predictable, (4) pain can be conceptualized as a conscious correlate of the implicit perception that the tissue is in danger. Signs of CS may include: spreading or mirror pain, pain without qualifying physical impairment, hyperalgesia, allodynia, concurrent psychological overlay or persistent pain beyond tissue healing time. The purpose of this paper is to describe a case of lumbar spinal stenosis in which treatment of CS led to marked improvement in function.

CASE DESCRIPTION: A 51-year-old woman with chronic low back pain and radiographic evidence of moderate central and foraminal spinal stenosis. Her chief complaint was central LBP with intermittent left lower extremity neurological symptoms extending to the foot that were aggravated by walking and standing, sitting and bending forward relieved her symptoms. She also reported that she had feelings of depression, anxiety and catastrophizing beliefs about her diagnosis. Her Oswestry Disability Index (ODI) = 50%, average numeric pain rating scale (NPRS) 5/10, patient-specific functional scale (PSFS) = 2.67 and fear avoidance beliefs questionnaire (FABQ) work = 21 and physical activity = 14. Initial physical examination was remarkable for: directional preference for lumbar flexion, left straight leg raise (SLR) at 70° elicited shooting pain down her leg, segmental hypomobility at L4-L5, aberrant lumbar motion and walking tolerance of 5 ft without lower extremity symptoms.

OUTCOMES: Initial intervention included: lumbar and hip manual therapy, neurodynamic mobilization, strengthening program, inclined treadmill walking and stationary bicycle. Her walking distances improved to 300 ft and she could tolerate 20 minutes of exercise. After this, her improvement began to plateau and neurophysiology pain education became the driving force in her treatment. She had marked improvement in ambulation distance without symptoms to >1000 ft and increased exercise time to 60 minutes. Her final ODI = 46%, average NPRS 3/10, PSFS = 5.33, Global Rate of Change +4, FABQ work = 17 and physical activity = 6. Functional gains were significantly improved particularly after the inclusion of neurophysiology pain education.

DISCUSSION: CS may be an overlooked component of common musculoskeletal conditions. In this case by using neurophysiology pain education to address CS, in conjunction with other physical therapy interventions, a successful outcome was achieved. Clinicians need to be aware of the symptoms of CS and role of the CNS in the treatment of individuals with musculoskeletal conditions.

OP02186

REDUCTION OF LOWER LIMB JOINT OSTEOARTHRITIS PAIN THROUGH USE OF AN ORTHOTIC INSOLE

Nelson BJ, Lehigh PL, Wright C, Avent R, Cappaert J, Lundy C, Anthony PA

Clinical and Claims Research, Schering-Plough Consumer Health Care, Memphis, TN; Foot Care Research and Development, Schering-Plough Consumer Health Care, Memphis, TN

PURPOSE/HYPOTHESIS: The study objective was to assess the effect of a nonwedge foam foot orthotic, identified as the Dr. Scholl’s Arthritis Pain Relief Orthotic, for relief of osteoarthritis (OA) related knee, foot, or hip pain as measured by the Visual Analog Scale (VAS) over a 3 week use period.

NUMBER OF SUBJECTS: 227 subjects with radiographic confirmed OA of the knee (88), foot (79), or hip (60) completed the 3-week clinical trial (98 men, 129 women; mean age, 56.8 [SD, 8.8] years, mean BMI = 29.4 [SD, 5.1] kg/m²).

MATERIALS/METHODS: Study inclusion criteria included (1) self-reported presence of pain in the knee, foot or hips, (2) OA diagnosis confirmed by an orthopedic surgeon through physical and radiographic examination and (3) pain from 2.5 to 9 on the VAS (10-cm scale). Subjects were provided insoles on a brand blinded basis for 3 weeks of unsupervised use. Pain was reassessed immediately upon insole use, after the initial 8 hours of use and once each week for 3 weeks of insole wear. Questionnaires were used to measure subject assessment of insole comfort, fit and benefit at all time points.

RESULTS: All reductions in pain were statistically significant at all time points following insole use (P<.05). Reductions in pain at the end of 3 weeks, expressed as change from baseline, were (1) Foot OA; Men –2.203 (SD, 1.817) P<.0001, Women –2.549 (SD, 2.080) P<.0001; 2) Knee OA; Men –2.073 (SD, 1.726) P<.0001, Women –2.177 (SD, 1.771) P<.0001; 3) Hip OA; Men –1.256 (SD, 1.730) P<.05, Women –2.430 (SD, 2.239) P<.0001. Percent reductions in pain and the associated statistical effect size calculations were Knee OA 42.3% (1.22), Hip OA 42.3% (0.97) and Foot OA 43.6% (1.22). Insole comfort assessment was statistically significant for positive perceptions of comfort for all subjects at all time points (P<.0001). All subjective questionnaire responses demonstrated positive agreement to insole use including allowing subjects to be more active (73%, P<.0001) and experiencing pain relief with each step (74%, P<.0001)

CONCLUSIONS: The use of a nonwedge foot orthotic was demonstrated to be effective in reducing joint pain experienced due to OA of the lower limbs when evaluated over a 3 week period of product use. The orthotic was shown to provide pain relief for foot, knee and hip-related OA and provided comfort during use.

CLINICAL RELEVANCE: OA affects more than 27 million US persons. The
Population incidence of lower extremity pain caused by OA is 34% in the foot, 65% in the knee, and 38% in the hip. Physical exercise is recommended for persons with OA to delay the progression of the disease. However, the pain associated with mild exercise, like walking, may limit successful patient compliance. Therapies designed to reduce pain while walking and during daily activities may be useful in managing OA of the lower limbs.

**CASE DESCRIPTION:** Patient 1 was a 70-year-old female with activity limitations of walking community distances, prolonged standing, and forward bending. Oswestry Disability Questionnaire (ODQ) score was 19/50 and Fear Avoidance Belief Questionnaire physical activity subscale (FABQ-PA) was 23/24. The Low Back Activity Confidence Scale revealed 19%, 100%, and 84% self-perceived confidence for function (LoBACS-FN), symptom self-regulation (LoBACS-SR), and exercise (LoBACS-EX), respectively. Key physical findings included gluteal weakness. Patient 2 was a 65-year-old female with activity limitations in ambulation, sitting tolerance and lying supine. ODQ was 23/50 and FABQPA was 6/24. She scored 19%, 73%, and 90% on the LoBACS-FN, LoBACS-SR, and LoBACS-EX, respectively. Key physical findings included hip extensor weakness, abdominal weakness, and lower limb neural tissue provocation. Individualized patient education based on CBT was provided to the patients in combination with a pragmatic approach to manual therapy and exercise that targeted specific body structure and function impairments. CBT techniques included cognitive restructuring, goal setting, activity pacing, problem solving strategies, graded exposure, and encouraging exposure to pleasant experiences.

**OUTCOMES:** Patient 1 was discharged after 7 visits over 21 weeks. Her ODQ score was reduced 40% and FABQPA score reduced 48%. The patient's scores were 19%, 87%, and 94% for LoBACS-FN, LoBACS-SR, and LoBACS-EX, respectively. Patient 2 was discharged after 7 visits over 18 weeks. At discharge, the patient's ODQ score reduced 45% and FABQPA score reduced 33%. Scores on LoBACS-FN, LoBACS-SR, and LoBACS-EX were 29%, 87%, and 100%, respectively.

**DISCUSSION:** This case report described the use of CBT techniques by a physical therapist to create an individualized patient education program for 2 patients with persistent LBP. Both patients demonstrated clinically significant improvements in disability at the end of treatment. Improvements in both self-efficacy beliefs and reduction in fear-avoidance beliefs may partially explain the improvements in disability. This may have been in response to the CBT-based interventions that were designed specifically to address those factors. Additional research seems necessary to determine best practices for CBT-based patient education by physical therapists.

**REFERENCES:**

Cognitive-behavioral therapy (CBT) is an effective method of intervention in patients with persistent pain. However, the pain associated with mild exercise, like walking, may limit successful patient compliance. Therapies designed to reduce pain while walking and during daily activities may be useful in managing OA of the lower limbs.
string tension were measured. A modified vernier caliper was used to assess medio-lateral location of the patella. Patellar mobility was evaluated with patellar tilt test. Kujala Test was used for analysis of performance of the subjects.

RESULTS: Wilcoxon signed-rank test indicated statistically significant improvements in pain, soft tissue flexibility and functional capacity for 2 groups after 6 weeks of treatment program (P<.05). However, no significant differences were found in patellar shift and patellar mobility (P>.05). Mann-Whitney U test showed that the group receiving kinesiotaping and exercises had better hamstring flexibility than exercise-alone group following treatment (P<.05). There were no significant differences between kinesiotaping and exercise group and exercise-alone group in terms of other parameters (P>.05).

CONCLUSIONS: These findings showed that over a period of 6 weeks a combination of kinesiotaping and exercises did not provide additional benefit to exercise alone in improving pain and function except for hamstring flexibility in individuals with patellofemoral pain syndrome.

CLINICAL RELEVANCE: The combination of kinesiotaping and exercise was not superior to the use of exercise alone in the treatment of PFPS.

OP02190

MANAGEMENT OF ANTERIOR HIP PAIN SECONDARY TO FEMORAL ANTERIOR GLIDE MOVEMENT SYSTEM IMPAIRMENT IN DANCERS: A CASE SERIES

Coll A, Fiori K, Cameron DM

Physical Therapy, Quinnipiac University, Hamden, CT

BACKGROUND AND PURPOSE: Normal arthrokinematics of the hip occur with appropriate muscle length and stability of surrounding connective tissue. An imbalance in these structures and hip extended posturing may cause excessive anterior glide of the proximal femur resulting in stress to the anterior hip structures, leading to anterior hip pain. This condition, believed to occur more commonly in dancers, has been identified as femoral anterior glide movement system impairment. The purpose of this study was to investigate the effectiveness of managing anterior hip pain presumed to be a result of femoral anterior glide movement system impairment in dancers.

CASE DESCRIPTION: Two dancers were chosen for participation based upon the following criteria: femoral anterior glide movement system impairment, anterior hip pain, at least 2 years dance experience and current dance frequency of at least 2 hours per week. Femoral anterior glide was determined by excessive anterior glide of the proximal femur during active straight leg raise (SLR), hamstring resistance while maintaining proper position of the femur during the confirmation test and delayed gluteus maximus contraction with prone hip extension for a positive hamstring dominance test. Both dancers were 21 years old with 15 years of dance experience. Six other dancers with hip pain were excluded from the study due to various reasons including history of trauma, history of hip pain, hip pain for over 6 weeks, hip pain for over 3 months, and hip pain for over 6 months. All dancers were female and all were receiving treatment for hip pain. Both dancers were chosen for inclusion because they had high levels of anterior hip pain and had not respond to previous treatments.

OUTCOMES: Global rating of change scale was +4/7 (“moderately better”) for Dancer 1 and +5/7 (“quite a bit better”) for Dancer 2 immediately after 4 weeks of intervention and at the 1 month follow-up. The hip outcome score showed functional improvements in both dancers after 4 weeks of intervention and at the 1 month follow-up. A modified version of the patient specific functional scale showed either no change or decreased difficulty with each specific dance move after the intervention phase. One month follow-up revealed slight to no difficulty on all movements for both dancers and fewer pain provocative tests. Impairments decreased upon reevaluation of the hip diagnostic examination after intervention. All positive labral tests before treatment were negative after 4 weeks of intervention. Several tests for femoral anterior glide (ie, active SLR and hamstring dominance) also improved.

DISCUSSION: Management of impairments and improving dance technique in 2 dancers with femoral anterior glide movement system impairment resulted in decreased pain and increased function.

OP02191

INTERRATER RELIABILITY OF A MUSCULOSKELETAL SCREEN AS ADMINISTERED TO FEMALE PROFESSIONAL CONTEMPORARY DANCERS

Karim A, Millet V, Olson S, Massie K, Morgenthaler A

Physical Therapy, Texas Woman’s University-Houston, Houston, TX

PURPOSE/HYPOTHESIS: Current studies on the incidence of injury among professional dancers indicate that 32 to 51 percent of dancers are injured annually. Given this high rate, screening tests have been developed as predictors of injury for use in preventive programs. There are currently numerous screens in use, with many incorporating a common set of sub-tests. While the development of a cohesive instrument is ongoing, many of the sub-tests used in our study are the same used in prior screens. To date there are no reliability or validity studies on the screening instruments that exist, although some components have been studied in a general population. The primary purpose of our study was to determine the interrater reliability of commonly used musculoskeletal screening components—specifically using a population of professional dancers.

NUMBER OF SUBJECTS: The study involved 30 female subjects from 6 contemporary dance companies between the ages of 18 to 32 years, with a mean age of 24 years, and BMI of 22.4.

MATERIALS/METHODS: There were 101 items/tester/dancer, assessed in the categories of Static Posture, the Brighton 9-Point Hypermobility Test, Flexibility, Strength, and Dynamic Posture. Tester training engaged specifically developed procedure and script, with prestudy practice obtained by screening 50 professional ballet dancers. Testing was nonordered, using 2 of the 4 available testers, with variable assignment of the lead tester. Data entry and statistical analysis were blinded and testers did not communicate the individually recorded results.

RESULTS: Percent agreement was reported for each test item. Kappa values were not reported because of skewing due to a prevalence effect. Spearman rho not utilized because of decreased validity due to lack of participant variability in test results. High percent agreement was found for the subcategories of hallux valgus, pelvic tilt, and forearm alignment, flexor hallucis, iliopsoas, hip internal rotation flexed, external rotation extended, and soleus extensibility, composite Brighton, and for most measures within the dynamic posture category. Low to moderate percent agreement was found in the strength tests.

CONCLUSIONS: Further test refinement is needed to improve the reliability of measurement components.

CLINICAL RELEVANCE: Overall, this musculoskeletal screen demonstrated moderate to high percent agreement between raters.

OP02192

IS SUPPORT MOMENT DURING SLOW SINGLE-LEGGED HOPPING INFLUENCED BY PATELLAR TENDINOPATHY?

Uriskač MC, Popovich JM, Aryan S, Asami DK, Chang Y-Jen, Souza RB, Kulig K

Division of Biokinesiology and Physical Therapy, University of Southern California, Los Angeles, CA; Division of Physical Therapy, University of North Carolina, Chapel Hill, NC; Department of Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA

PURPOSE/HYPOTHESIS: The purpose of this study was to compare the kinetic strategies of dancers with and without patellar tendinopathy (PT) during a slow, controlled, single-legged hopping task. Single-legged hopping was chosen as this task is neither practiced nor sport-specific and therefore may allow for analyses of movement patterns that are not affected by...
learned compensations.

**NUMBER OF SUBJECTS:** Fourteen dancers (7 with PT) aged 19.1 ± 1.6 years from preprofessional dance programs participated.

**MATERIALS/METHODS:** Three dimensional kinematic and kinetic data were recorded using an 8-camera motion analysis system (Vicon, 250 Hz) and a force platform (AMTI, 1500 Hz). Subjects were instructed to perform a single-legged hopping task with arms crossed over the chest at 1.67 Hz using a digital metronome with audible and visual feedback. A trial was considered successful if the following criteria were met: (1) foot completely cleared the ground and (2) hop occurred within ± 5% of the designated frequency. A minimum of 10 successful trials were used for analysis. Lower extremity kinematics and kinetics were calculated with Visual3-D software, using a standard inverse dynamics approach. Support moment (SM) was calculated as the averaged sum of ankle, knee, and hip net joint moments (NJM). Independent samples t tests were conducted to determine if there were significant differences between the controls and PT group, with significance level set as P<.05. Results for peak extensor and mean sagittal plane NJM values during ground contact phase (GCP) are reported as mean ± standard deviation (control, tendinopathy; P value).

**RESULTS:** The subjects with PT demonstrated a significantly lesser peak (6.71 ± 1.15, 5.55 ± 0.45; P = .03) and average (3.44 ± 0.36, 2.96 ± 0.25; P = .014) SM across GCP. There was no difference in peak ankle NJM (2.78 ± 0.55, 2.43 ± 0.31; P = .17) or peak knee NJM (2.47 ± 0.67, 2.21 ± 0.29; P = .36); however, the PT group had a significantly lesser peak hip NJM (1.64 ± 0.24, 1.23 ± 0.42; P = .04). Mean ankle NJM (1.74 ± 0.27, 1.39 ± 0.11; P = .20), knee NJM (0.91 ± 0.25, 0.79 ± 0.10; P = .29), and hip NJM (0.80 ± 0.15, 0.58 ± 0.25; P = .07) were also lesser in the PT group, but not significantly different across GCP.

**CONCLUSIONS:** Dancers with PT were able to successfully accomplish the same controlled task with a 17% lesser SM through the combined effect of lesser extensor moments at the ankle, knee, and hip joints. Statistically, only the difference in peak hip extensor moment was significant. The 25% lesser extensor moment at the hip in the PT group suggests that the hip was the major contributor to the difference in SM between groups.

**CLINICAL RELEVANCE:** More effective strategies to prevent or treat PT will be aided by identifying predisposing factors and/or adaptations to this pathology. Our results indicate that these interventions should be directed at the hip.