

ABSTRACTS: AAOMPT CONFERENCE, 2007

The following abstracts are to be presented at the 13th annual meeting of the American Academy of Orthopaedic Manual Physical Therapists held in St Louis, Missouri from October 19–21, 2007. Presentations are either by poster or platform. These abstracts were peer-reviewed by an AAOMPT committee prior to acceptance for presentation at the AAOMPT conference. However, inclusion of an abstract in this supplement does not constitute a peer-reviewed journal publication. The publication of abstracts alerts readers to research that is presently being conducted. It is hoped that the research presented here in brief will eventually be submitted as full-length manuscripts for review and potential publication.

LATERAL KNEE PAIN TREATED WITH PROXIMAL TIBIOFIBULAR JOINT MANIPULATION: A CASE REPORT

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Purpose: A positional fault of the fibula relative to the tibia is thought to occur following lateral ankle sprain and can lead to decreased ankle dorsiflexion over time. Limited ankle dorsiflexion alters loading of the ankle and knee joints, which can lead to pain. The purpose of this case report was to describe the treatment of lateral knee pain in a recreational runner with a prior history of an untreated ipsilateral ankle sprain. **Subject:** A 24-year-old female recreational runner with a 3-month history of right lateral knee pain. Past medical history included a right lateral ankle sprain approximately 6 years previously that was not evaluated or treated. During the initial evaluation decreased ankle dorsiflexion range of motion (ROM) and hypomobility of the right proximal and distal tibiofibular joints was present. **Methods:** The patient was treated three times over the course of two weeks. Pain was measured utilizing a Visual Analog Scale (VAS). Functional movement was assessed using a unilateral Step Down Test and outcome measured using the Short Form Activity Measure for Post-Acute Care (AM-PAC). Outcome measures were reassessed immediately following the initial treatment session and during two follow-up visits. The patient was treated initially with high-velocity thrust (HVT) manipulation to the proximal tibiofibular joint. Additionally, the patient was educated and performed a home exercise program including hip strengthening, closed chain exercises, and gastrocnemius/soleus complex stretching. **Results:** Initial VAS scores were 0/10 best/current and 5/10 at worst during running. Active dorsiflexion ROM of the left ankle was 15° with knee extended and flexed, the right ankle was 5° with knee extended and 8° with knee flexed. Right ankle dorsiflexion ROM increased 5° with knee extended and 4° with knee

flexed immediately following the HVT to the proximal tibiofibular joint. The Step Down Test score improved from 5/6 prior to treatment to 3/6 immediately following treatment. During the next visit the patient indicated she was able to run after the first visit without pain (VAS worst 0/10). At the second visit on reassessment the ankle ROM changes were maintained from the first visit. The Step Down Test score was 3/6 on reassessment and the AMPAC score changed from 76.58 to 81.53 from the first to the second visit. During the third visit ankle dorsiflexion ROM was 15° with knee extended and 20° with knee flexed and the Step Down Test score improved to 2/6. At this time the patient reported no complaints of lateral knee pain when running (VAS worst 0/10) and the AM-PAC score remained at 81.53. **Conclusion/Clinical Relevance:** A patient reporting lateral knee pain was treated with HVT of the proximal tibiofibular joint. Hypomobility of this joint was thought to be a result from previous lateral ankle sprain. The interrelationship of the joints in the lower extremity should be assessed in patients with lower extremity pain. The use of specific joint mobility testing related to altered lower extremity biomechanics needs to be researched in patients with lower quarter pain.

ENDURANCE OF LOW BACK MUSCULATURE IN HIGH SCHOOL ATHLETES: A STUDY OF GLOBAL VERSUS ISOLATED LOW BACK STABILIZATION EXERCISES

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Purpose: Current evidence regarding the use of specific muscle groups for trunk stabilization exercises has been debatable. Due to this controversy and the lack of research in this specific population, our purpose was to investigate the most effective stabilization pro-

gram to improve trunk endurance in high school weightlifting athletes. Gaining this knowledge would help health care providers to most efficiently and effectively treat low back pain in this population. Rehabilitation and strength/conditioning professionals working with high school athletes could also use the initial endurance values gleaned from this study with regard to determining muscle imbalances. **Subjects:** Thirty-three high school students participating in one of three weight lifting/conditioning classes at a local high school were used as a sample of convenience. Each subject was screened for eligibility. Eligible subjects who consented to participate were randomly assigned to one of the three groups: global muscle group strengthening (n=12), isolated muscle group strengthening (n=11), and a control group (n=10). **Methods:** Four timed isometric endurance tests of trunk musculature were used in this study: extensor endurance test, flexor endurance test, and the side bridge test bilaterally. All tests were completed as previously described with modifications due to equipment availability. Both intervention groups performed previously published exercise programs except that the isolated muscle-strengthening group was instructed in a trunk-bracing maneuver prior to performing the exercises. A two-way ANOVA for each endurance test was used. Post-hoc analysis included a one-way ANOVA and an independent t-test with a Bonferroni adjustment with a paired t-test for time. **Results:** No significant difference ($P>0.05$) existed between the isolated and global trunk endurance groups and the control group. Further data analysis showed no significant difference in endurance times with regard to age or gender. **Conclusion/Clinical Relevance:** In terms of measuring isometric endurance times in high school athletes, no benefit is apparent for prescribing an isolated program as compared to a global program. There also appears to be no significant value in prescribing a specific trunk stabilization program versus traditional weightlifting exercises for improvement of trunk endurance. Clinically, the isolated and global endurance programs may be equally beneficial to high school athletes. An athletic population already engaged in weightlifting may require a specifically advanced trunk stabilization program to demonstrate benefit for trunk endurance. Additional research should investigate more advanced trunk stabilization exercise benefits for improved trunk endurance, as well as correlations between specific interventions and performance in specific parameters (speed, agility, etc.). Professional judgment should be the guide when treating this population.

THE UTILIZATION OF MANIPULATION BY FIRST PROFESSIONAL PHYSICAL THERAPY STUDENTS AND CLINICIANS: AN ANALYSIS OF INFLUENTIAL FACTORS

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Purpose: The purpose of this study was to describe current practices and factors influencing utilization of manipulation skills for practicing clinicians, clinical instructors, and physical therapy students and to investigate the influence of a continuing education course on utilization of and comfort level with manipulation skills. **Subjects:** Forty-three students enrolled in the final year of an entry-level doctorate of physical therapy program, their clinical instructors, and 122 licensed physical therapists participating in a continuing education course co-sponsored by the American Academy of Orthopedic Manual Physical Therapists in 2005. **Methods:** Survey instruments were developed and validated by academic physical therapists actively involved in manipulation education for entry-level students. Survey items investigated the use of and comfort level with performing and instructing non-thrust and thrust manipulation techniques. The first questionnaire was distributed electronically to clinical instructors and students while on full time clinical rotations. The second questionnaire was distributed to licensed physical therapists before and 6 months after taking the manipulation course. **Results:** The response rate was 43 (100%) for students, 5 (12%) for clinical instructors, and 122 (100%) for course participants at initial and 30 (24.5%) at 6-month follow up. Students reported greater comfort in performing both thrust and non-thrust techniques than the clinical instructors. The primary reason cited by students for not performing manipulation techniques was lack of appropriate patient population. The clinical instructors' greatest concern in performing manipulation techniques was lack of personal skill level which may be related to the limited amount of clinical instructors, who received instruction in non-thrust (60%) and thrust techniques (20%) in their entry-level education programs. Following participation in a continuing education course, there was a significant increase in the number of clinicians utilizing thrust techniques (62% to 85%; $P=0.016$), particularly for the lumbar spine, greater comfort level with performance of thrust techniques for the thoracic and lumbar spine, and a greater number, who allowed students to practice thrust manipulation techniques on their patients (63.9% to 83%; $P=0.042$). **Conclusion/Clinical Relevance:** Disparities exist between students and clinical instructors with regard to education in, utilization of, and comfort level with manipulation techniques. These disparities affect students' ability to practice manipulation techniques during their clinical education experiences. Participation in a continuing education course resulted in a significant increase in the overall utilization of thrust manipulation. Proficiency in manipulation is vital to the future of physical therapy practice. Continued efforts should be made to assure that manipulation education is a component of entry-level curricula and continuing education offerings.

MANAGEMENT OF A PATIENT WITH ACUTE LOW BACK PAIN USING THE LUMBOPELVIC REGION MANIPULATION CLINICAL PREDICTION RULE AND THE TREATMENT-BASED CLASSIFICATION SYSTEM

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Purpose: The treatment-based classification (TBC) of Delitto et al has been shown to result in better clinical outcomes than standard physical therapy (PT) for patients with acute low back pain (LBP). A clinical prediction rule has been reported to be useful for identifying subgroups of patients that are likely to respond to lumbopelvic region manipulation. However, a more recent report suggests that the actual thrust manipulation technique that is used for these patients may not alter clinical outcomes. The purpose of this case report was to describe the clinical decision-making process and manual physical therapy management of an individual who met the criteria for the lumbopelvic region manipulation clinical prediction rule. **Subject:** A 29 year-old male who reported an initial onset of sharp, stabbing central LBP after loading groceries into his car 3 days prior to presenting to PT. He did not have a previous history of low back pain. His Oswestry Disability Index (ODI) score at the time of the initial PT visit was an 80, his Fear Avoidance Beliefs Questionnaire Work subscale was a 12, and his resting pain was an 8/10 on a numerical pain rating scale (NPRS). **Methods:** The history and physical examination revealed that he had 1) recent onset of symptoms, 2) no symptoms distal to the knee, 3) hypomobility with spring testing of the lumbar spine, 4) hip internal rotation of 15° on the right and 20° on the left, 5) lumbar spine flexion of 52° (measured with a single bubble inclinometer), and 6) lumbar spine extension of 10° with left sided low back pain. Based on the clinical prediction rule guiding the use of manipulation in the lumbar spine, a supine lumbopelvic region thrust manipulation targeting the right side was attempted twice without cavitation. The same technique was performed once again targeting the left lumbopelvic region, and cavitation was noted. The patient's pain immediately decreased to a 6/10, and his lumbar flexion increased to 105°. Extension remained status quo. The patient was then positioned in left-sidelying, and a neutral spine rotation manipulation was performed resulting in a decrease in resting pain to a 1/10. The patient was then able to extend to 28° without LBP. The patient was instructed in a home program of pelvic tilts, single and double knee to chest exercises, prone press-ups, and walking as tolerated. Subsequent treatments consisted of the same manual therapy interventions described above, as well as range of motion and trunk stabilization exercises. **Results:** The patient was seen for 4 visits over the course of 14 days. After the first visit, he was able to discontinue all medications. His ODI score decreased from an 80 to a 20 after one visit, and was a 10 at discharge. His pain had decreased from an 8/10 to a 0/10 at rest. He had full range of motion and was able to perform all of his activities of daily living without pain. **Conclusion/Clinical Relevance:** It has been reported that the TBC has good in-

terrater reliability and leads to improved outcomes when compared to treatment that is not classification-based. This case report describes the examination findings, clinical decision-making, and outcomes of a patient that met the criteria for the manipulation classification, and all 5 items of the clinical prediction rule for lumbopelvic region manipulation. This patient achieved dramatic improvement in function as reflected by a 70-point reduction in the ODI score in 14 days. Additionally, dramatic improvements in impairments and disability occurred within-session with a combination of the lumbopelvic region manipulation and a rotational lumbar spine manipulation.

CLINICAL EXAMINATION OF A CONGENITAL UPPER CERVICAL INSTABILITY IN A PATIENT WITH CERVICOGENIC HEADACHES

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Purpose: The lifetime prevalence of headache has been estimated to be 93-98%, and up to 17.8% of headache sufferers meet the International Headache Society classification criteria for cervicogenic headache. Jull et al have demonstrated that a combined program of manipulative therapy and exercise can reduce the symptoms of cervicogenic headache. The role of pre-manipulative testing of the cervical spine is an area of intense controversy, and there is very little data to inform practitioners on the appropriate use of ligamentous stability tests when assessing the upper cervical spine. The transverse ligament test (also commonly known as the anterior shear test) is commonly taught in entry-level physical therapy programs; however, to our knowledge no evidence exists to support that the test is valid in clinical practice. The purpose of this case report was to describe the clinical decision-making process in the management of an individual with chronic headaches and signs and symptoms suggestive of upper cervical instability. **Subject:** A 23-year-old female was referred to physical therapy by a neurologist with intractable musculoskeletal headaches. Her Neck Disability Index (NDI) score was a 54% and she rated her headache pain from a 3-9/10 on a Numerical Pain Rating Scale (NPRS). She did relate a previous history of paraesthesiae into the lower extremities without current symptoms. She was treated in physical therapy for 11 visits over the course of two months without significant long-term improvement, at which time she was referred to the primary author for a second opinion and potential manual therapy interventions. **Methods/Results:** Initial neurological screening examination was unremarkable. Assessment of the transverse ligament in the upper cervical spine was done in supine where the therapist places the index fingers in the space between the occiput and C2 spinous process so that the fingertips are overlying the neural arch of C1. The head and C1 are carefully lifted anteriorly together. The patient had the onset of burning dysaesthesia in the left leg and paraesthesiae in the right leg. These symptoms continued when we sat the patient

up. The paraesthesiae continued after the cessation of the test. The patient was then asked to sit up and a Sharp-Purser test was performed, which resulted in a decrease in the paraesthesiae. The patient was then referred back to her primary care physician for further evaluation. Subsequent radiographs and magnetic resonance imaging revealed that the subject had a type II C2-3 Klippel-Feil congenital fusion and os odontoideum. Os odontoideum describes a condition in which the dens is separated from the body of the axis. She was examined by a neurosurgeon who concluded that she was not a surgical candidate. Her neurological symptoms resolved over time, but she continued to have headaches. **Conclusion/Clinical Relevance:** Os odontoideum is a clinically important condition given that the mobile dens may render the transverse ligament incompetent, leading to atlantoaxial instability, and potentially devastating consequences to the upper cervical cord or vertebral artery. The results of this case report suggest that physical therapists should be cognizant of this condition and consider screening the upper cervical ligaments prior to manual or mechanical interventions to this region.

CLINICAL CHARACTERISTICS SEEN IN PATIENTS WITH LUMBAR DISC DISEASE

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Purpose: High prevalence and associated cost of lumbar disc disease (LDD) in industrialized countries are well known. Risk factors for LDD have been described on individual, psychosocial, and occupational bases as well as with anatomic and biomechanical causal factors. Recent studies demonstrated genetically mediated contributions to LDD. A link between genetic factors and LDD may have clinical implications for diagnosis, classification, and management of patients with LDD. However, competing genetic studies differ in operationally defining LDD, research design, and methodologies, making it difficult to replicate and verify claims. A clear description of the clinical presentation of LDD is required to define an LDD phenotype operationally. The purpose of the current study was to clarify clinical characteristics of LDD. **Subjects:** 3212 (1304 men, 1908 women; mean age 44.43 yr±11.39) physical therapy patients with low back pain selected from the FOTO™ database. **Methods:** With retrospective dataset analysis, investigators classified patients into 2 groups based on ICD-9 diagnostic codes: LDD or non-disc related low back pain. Logistic regression forward selection was used to test age, sex, symptom onset, height, weight, obesity, intake functional scale, anxiety, depression, incontinence, accident history, medication use, arthritis, pulmonary disease, angina, myocardial infarction, gastrointestinal condition, visual or hearing impairments, osteoporosis, kidney impairment, DJD, and intake numeric pain score as predictors of LDD diagnosis. Selected predictors were then compared between patient groups. **Results:** Symptom onset, age, height, intake functional scale, accident history, and anxiety predictors met significance (0.05) for entry into the regression

model. When controlling for all other predictors: (1) symptom onset and accident history were positively associated with LDD diagnosis (OR=1.293, P<0.0001; 95% CI: 1.188, 1.406), (OR=1.495, P=0.0012; 95% CI: 1.171, 1.907); (2) the odds of being diagnosed with LDD decreased for those with anxiety (OR=0.671, P=0.0197, 95% CI: 0.480, 0.938). Age, height, and intake functional status odds ratios were close to one, thus weak as predictors for LDD diagnosis. The LDD and non-disc related groups differed in age (t=-3.99, P<0.0001), sex ($\chi^2=4.3142$, P=0.0378), intake functional scale (t=2.55, P=0.0107) and symptom onset ($\chi^2=47.84$, P<0.0001). **Conclusions/Clinical Relevance:** These preliminary data indicate age, height, intake functional scale, symptom onset, anxiety, and accident history may be important clinical characteristics to distinguish patients with LDD from those with non-disc related low back pain. These clinical characteristics should be further tested with diagnostic imaging and genetic testing in a prospective study so clinicians may link clinical presentation with more specific classification methods and intervention to improve LDD management.

PHYSICAL THERAPY INTERVENTIONS TO IMPROVE LUMBAR SPINE RANGE OF MOTION AND NEURODYNAMICS IN A PATIENT WITH BILATERAL CALF PAIN

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Purpose: The purpose of this case report is to evaluate the effectiveness of physical therapy interventions to improve lumbar spine range of motion and neurodynamics in a patient with bilateral calf pain in the absence of low back pain. Research regarding the use of physical therapy interventions to treat the lumbar spine to affect change in the lower extremities in the absence of low back pain is limited. **Subject:** The patient was a 49-year-old male fork-lift driver and soccer coach, who presented with a chief complaint of bilateral calf "heaviness" or "tightness", and a "burning" sensation in plantar surface of both feet, which was worse at night, disrupted sleep and limited running. During the initial evaluation, the patient was unable to perform 20 unilateral heel raises or standing lumbar active flexion range of motion without symptom provocation. The patient also had a positive straight leg raise bilaterally. Qualitative analysis of active lumbar range of motion revealed limited movement of lower lumbar motion segments, particularly into extension. **Methods:** The patient attended five physical therapy visits that included manual therapy and instruction in a home exercise program, including exercise to improve neurodynamics. Manual therapy interventions included three sessions of central and unilateral posterior-to-anterior mobilization to the lower lumbar spine and one session of general lumbar rotations. **Results:** After five physical therapy visits over the course of six weeks, the patient reported complete resolution of symptoms, including being able to sleep through the night uninterrupted. He was also able to run and returned to playing and coaching soccer without symptom reproduction. His overall active lumbar range of motion did not change. **Conclusion/Clinical Relevance:**

vance: Physical therapy interventions chosen for this patient appeared to be effective in the management of bilateral calf symptoms in the absence of low back pain. These results suggest further research would help determine if physical therapy interventions chosen in this case report are effective in treating lower extremity symptoms in the absence of low back pain. Additional investigation of tests and measures of lumbar range of motion that are valid and sufficiently sensitive to detect change would be helpful to guide clinical decision-making in patients with minimally impaired mobility in the lumbar spine. In the presence of bilateral lower extremity symptoms without a direct cause, such as trauma or injury to the affected area, a thorough examination of the lumbar spine is warranted despite the absence of low back pain. Also in the presence of altered neurodynamics, treatment interventions restoring mobility of the somatic structures in which the nerve travels, as well as the gliding of the peripheral nerve through those structures, is important to restore mobility to the entire system.

A COMPARISON OF MECHANICAL DIAGNOSIS AND THERAPY AND GENERALIZED APPROACHES IN THE MANAGEMENT OF WORK-RELATED LOW BACK PAIN

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Purpose: The purpose of this study was to examine the effectiveness of Mechanical Diagnosis and Therapy (MDT) in comparison with other approaches in the treatment of work-related acute and sub-acute low back pain. **Subjects:** 130 physical therapy patient charts were examined from outpatient physical therapy sites of the Catholic Health System of Western New York. The patient outcomes were tracked with the LIFEware System outcome measure. Twenty-seven subjects met the inclusion criteria with 17 subjects treated by certified MDT physical therapists and 10 subjects treated by non-certified MDT physical therapists. Of the 17 qualified subjects in the certified MDT group, 10 were selected at random to provide equal group numbers for comparison. There were eight male and two female subjects in the certified MDT group and 6 male and 4 female subjects in the non-certified MDT group. **Methods:** A retrospective chart review of patients with acute and sub-acute work-related low back pain was conducted during the fall and spring of 2006 from physical therapy patients treated in the Catholic Health System of WNY in 2005. The LIFEware measure was completed by the subjects during their initial physical therapy visit and repeated upon discharge from physical therapy. The LIFEware scores were analyzed for changes in Body Movement and Control (physical functioning), Effort (physical activity), Visual Analog Scale (VAS), Absence of Pain, Driving Difficulty, Placid (affective well being), and Overall Satisfaction with Life (affective well being). A 2-sample t-test was used for statistical analysis of the seven LIFEware variables and total physical therapy treatment visits. **Results:** Body Movement and Control demonstrated statistical significance for both total percent change pre-test and post-test ($P=0.012$), and percent

change per physical therapy visit ($P=0.045$). The total number of physical therapy treatment visits was, on average, 9.40 ± 3.34 (SD) visits for the certified MDT group and 15.90 ± 12.87 visits for the non-certified MDT group. Seven of the 10 subjects in the certified MDT group had returned to full work status at time of discharge. **Conclusion/ Clinical Relevance:** For all measured variables, subjects treated by physical therapists certified in MDT demonstrated more favorable results when compared to subjects treated by physical therapists who were not certified in MDT, with differences in Body Movement and Control meeting statistical significance. The results of this study may point to treatment effectiveness being fostered by specialization in a particular treatment approach.

JOINT MOBILIZATION AND VOLITIONAL CONTRACTION MODULATE FLEXOR WITHDRAWAL RESPONSES IN SUBJECTS WITH KNEE OSTEOARTHRITIS

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Purpose: Patients with chronic pain often present with hyperalgesia, possibly due to hyperexcitability of pain pathways. The aim of the present study was to investigate alterations in spinal flexor reflex excitability in individuals with knee osteoarthritis (OA) and to examine the potential effect of oscillatory joint mobilization on this reflex. **Subjects:** Ten subjects with and 10 without knee OA (age 45-75) were recruited. Exclusion criteria included history of neurological disease or insult, diabetes, or total joint arthroplasty. Subjects were instructed to avoid arthritis medications on the day of testing. **Methods:** The Visual Analog Scale (VAS) was completed prior to testing, rating worst and average pain of the previous week, and was completed during each component of the testing protocol. Subjects were seated with their tested limb attached to a footplate instrumented with a 6 degree of freedom load cell, with surface electromyographic (EMG) recordings obtained from the tibialis anterior, rectus femoris, medial gastrocnemius, and hamstrings. Noxious electrocutaneous stimulation was applied at the medial arch of the foot (monophasic, 1 ms pulses, 50 Hz for 200 ms) at 1X, 2X and 3X the threshold of the tibialis anterior EMG-response. Responses at 2X threshold were recorded after each following condition: a maximal leg press task, a sham hands-on treatment (6 min), and Grade III accessory joint mobilization (2 intervals of 3 min). Joint torques at hip, knee, and ankle were calculated, with peak reflex torques normalized to body mass and compared using repeated measures ANOVA. Amplitude of muscle activation as measured by EMG was normalized within-subjects to 2X threshold response. **Results:** Decreased threshold to flexor withdrawal response was found in the OA group (mean= 10.2 ± 3.6) as compared to the control group (mean= 14.6 ± 4.3 ; $P=0.05$), with increased ankle torques. Muscle responses were augmented in the OA group following the forceful

co-contraction task yet remained unchanged or diminished in controls ($P=0.04$). Reflex responses were reduced following joint mobilization ($P=0.06$) and pain levels as measured by the VAS were decreased. **Conclusion/Clinical Relevance:** Joint compression in an osteoarthritic knee may enhance nociceptive reflex responses, while joint mobilization appears to be effective in reducing pain and nociceptive responses in individuals with OA of the knee.

THE EFFECTS OF C5-C6 HIGH-VELOCITY LOW-AMPLITUDE THRUST MANIPULATION ON RESTING ELECTROMYOGRAPHIC ACTIVITY OF THE BICEPS BRACHII MUSCLE

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Purpose: There is a significant gap in the literature regarding the effects of spinal manipulation on extremity muscles, that is, whether or not muscles this far removed and not anatomically connected to the vertebral column by an origin or insertion point, experience any alteration in resting myoelectric activity following spinal manipulation of segmentally associated facet joints. This study evaluated the effect of high-velocity low-amplitude thrust manipulation (HVLAT) to the right C5-C6 facet joint on resting electromyographic (EMG) activity of the right and left biceps brachii muscles in healthy asymptomatic subjects. **Subjects/Methods:** Using a placebo-controlled, single blind, repeated measures design, 54 healthy asymptomatic subjects were used to investigate the effect of HVLAT manipulation to the right C5-C6 zygapophyseal joint on the resting EMG activity of the right and left biceps brachii muscles. EMG data were recorded for 30-second intervals before and after the HVLAT manipulation, the sham manipulation, and the control condition. **Results:** The results demonstrated that the HVLAT manipulation produced an excitatory effect on upper limb muscle tone, as evidenced by an immediate increase in resting EMG activity of 94.20% ($P=0.000$) and 80.05% ($P=0.000$) to the right and left biceps brachii muscles, respectively. Furthermore, the group of subjects that did not experience cavitation following HVLAT manipulation achieved greater increases in the resting EMG activity of both the right ($P=0.000$) and left ($P=0.014$) biceps brachii muscles than those subjects that did experience cavitation. In addition, following HVLAT manipulation to the right C5-C6 facet joint, the magnitude of the mean change in resting EMG activity of the right biceps brachii muscle was significantly greater than the magnitude of the mean change in the left biceps brachii ($P=0.011$). **Conclusion/Clinical Relevance:** The results of this study allow for the conclusion that a single HVLAT manipulation to the cervical spine elicits a short-term increase in resting EMG activity of the elbow flexors. In addition, this study revealed that HVLAT manipulation to the zygapophyseal joints on the right side of the cervical spine immediately increases resting motor activity of both the right and left biceps brachii muscles. This study also substantiates the theory that increased resting EMG activity of the elbow flexors occurs immedi-

ately following HVLAT manipulation whether or not the cavitation phenomenon is present.

UTILIZATION OF CLOSED-CHAIN EXERCISE COMBINED WITH PHYSICAL THERAPY WITHIN ONE WEEK FOLLOWING UNILATERAL TOTAL KNEE REPLACEMENT (TKR) SURGERY

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Purpose: Studies defining specific physical therapy protocols that set out to ameliorate strength and weight-bearing asymmetry after unilateral TKR are limited. Our intention was to assess an aggressive, closed-chain exercise protocol that could minimize the strength and weight-bearing asymmetry evident within the first 60 days following primary unilateral knee joint replacement. **Subjects:** 26 individuals, who had primary unilateral knee replacement, were randomly assigned into two groups before beginning outpatient physical therapy within one week of having the procedure. The control group ($n=14$, 7M/7F; mean age 69.57) had the standard physical therapy protocol while the experimental group ($n=12$, 7M/5F; mean age 68.67) received the standard protocol plus a one-legged horizontal press exercise. **Methods:** A horizontal leg press was used to determine lower limb force producing ability of each limb during a one-legged horizontal press and for training during Physical Therapy (PT) sessions. Weight used for training was determined by calculating a 1RM based on Holten's diagram. Initial training was directed at endurance and tissue-related swelling. By the second week, each subject in the intervention group was completing both strength and endurance training. For each week and for each individual in both groups, we calculated a Load*Volume index or Load (lbs.) x Volume (# reps.). Load*Volume (LV) was calculated for both the involved and uninvolved sides. Weight bearing during a squat to 60° of knee flexion was determined by using a force platform (NeuroCom International, inc., Clackamas, OR), which calculated the percentage of body weight placed on each limb during the squat. We calculated a strength and weight bearing asymmetry index by dividing the result of the involved side by the score of the uninvolved side. We used a Mann-Whitney test to assess for differences between groups for weight bearing asymmetry index during the squat at discharge. **Results:** In the control group, the greatest average LV asymmetry occurred at week 1 (0.32). Average LV asymmetry improved through week 2 (0.58) followed by improvement through weeks 3 and 7 (range 0.64-0.74). The least average LV asymmetry noted in this group was 0.66 and 0.74 at week 6 and week 7, respectively. In the experimental group the greatest average LV asymmetry index occurred at week 1 (0.30) with a weekly improvement (range 0.44-0.90) through week 7. The least asymmetry occurred at week 6 (0.78) and week 7 (0.90). For the squat at 60° of knee flexion, both groups had similar asymmetry indices before the initiation of PT: experimental (0.57) and control (0.58). At discharge

from therapy, the asymmetry index was not statistically different between groups ($P=0.374$). The experimental group had a higher asymmetry index (0.78) compared to the control group (0.70). **Conclusion/Clinical Relevance:** Individuals within one week after PT were able to begin a specific lower limb exercise with the distal segment fixed without difficulty. Individuals in the experimental group had less lower limb strength asymmetry and greater weight bearing symmetry during the squat. Obviously sample size is small, however, our study suggests that physical therapists should consider utilizing more demanding rehabilitation protocols in minimizing the strength and weight bearing asymmetry that is evident after unilateral knee joint replacement.

CARDIOVASCULAR RESPONSE TO NOXIOUS MANUAL PHYSICAL THERAPY INTERVENTIONS IN HEALTHY FEMALES

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Purpose: Manual procedures used in orthopedic physical therapy practice are commonly painful. The purpose of this study was to determine the cardiovascular response of healthy females to two of these techniques, stretching and deep soft tissue mobilization (STM). Our hypothesis was that heart rate (HR) and blood pressure (BP) increase in response to noxious STM and stretching. **Subjects:** 33 females. **Methods:** A randomized pretest-posttest control group design with control and experimental groups was used. Initial BP, HR and pain levels were taken. Interventions included a stretch administered to either the hamstrings or the neck lateral flexors for 1 minute and STM administered to either the upper trapezius or piriformis region for 2 minutes, all within the subjects' pain tolerance. The control group received identical but painless intervention. BP was recorded every 30 seconds and HR and pain levels were recorded every 15 seconds until they returned to baseline. Group demographics as well as HR and BP means were analyzed with significance set at 0.05. **Results:** There was no statistically significant difference between the control and experimental groups for mean age, initial pain level, HR, and systolic and diastolic BP. The mean increase in pain was 0.1 for the control group and 6.1 for the experimental group (0-10 scale). The control group HR decreased by 2.1% during the sham intervention, whereas the experimental group HR increased 4.0%. Control group systolic BP decreased 1.0% and experimental group systolic BP increased 2.0%; diastolic BP for the control group increased 2.3% and experimental group diastolic BP increased 4.8%. Mean HR as well as systolic and diastolic BP changes were statistically significant with a medium effect size in all cases. **Conclusion/Clinical Relevance:** Results indicate significant differences in HR and BP change between a control and experimental group of adult females during painful manual interventions. Thus, noxious physical therapy interventions have an effect on the cardiovascular system, which may have implications for patients with cardiovascular pathology. These differences may have significant repercussions for patient care. More research investigating systemic responses to manual therapy is needed if physical thera-

pists are to offer best patient care as autonomous practitioners. Manual physical therapy interventions are commonly painful, and patients with chronic pain to whom these techniques are commonly applied are primarily female. Previous investigation has shown BP rises in response to pain; however, no literature regarding the cardiovascular response to noxious manual therapy interventions was identified. This study provides insight into common interventions whose effects are not well understood in terms of the cardiovascular response in females. Physical therapists can use this information to be more aware of changes that may occur in patients during painful treatments. This study also provides a baseline for future investigations into physiological responses with patients, who have pathology.

EFFECTS OF LUMBOPELVIC JOINT MANIPULATION ON QUADRICEPS ACTIVATION OF HEALTHY INDIVIDUALS

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Purpose: Lumbopelvic joint manipulation has been shown to increase quadriceps force output and activation, but the duration of effect is unknown. The purpose of this research was to determine the magnitude and duration of changes in quadriceps force output and activation following a single lumbopelvic treatment over the course of one hour. **Subjects:** Forty-two healthy volunteers (age=28.3±7.3yr; ht=172.8 ±9.8cm; mass=76.6±21.7kg) with no history of spinal or lower extremity pathology or injury within the past 6 months. **Methods:** Quadriceps force and activation were measured using the burst-superimposition technique during a seated isometric knee extension task. The supramaximal electrical stimulus was used to augment maximal voluntary isometric contraction (MVIC) force during knee extension. Amount of quadriceps activation was quantified by using the central activation ratio (CAR) and calculated by dividing the MVIC force by total force (combined effect of the electrical superimposed burst stimulation upon the MVIC). Subjects performed 3 trials during each time interval, with the mean utilized for data analysis. Following baseline testing, subjects were randomly assigned to one of three groups (lumbopelvic joint manipulation, passive range of motion, or prone extension). Subjects were then reassessed immediately and 20, 40, and 60 minutes following intervention. Two separate single factor repeated measures ANOVAs were performed to compare quadriceps force output and activation percent change scores from baseline between groups across each time period. **Results:** There was not a significant ($P>0.05$) interaction (time x group) or between-groups effect for quadriceps force or activation. There was a significant ($P<0.001$) change in quadriceps force over 60 minutes without changes in activation ($P>0.05$). Compared to baseline, quadriceps force significantly decreased ($P<0.01$) following intervention at all time intervals. Separate post-hoc one-way ANOVAs were used to examine immediate changes in quadriceps force and activation following intervention. Immediately following lumbopelvic joint manipulation

there was a significant increase ($P<0.05$) in quadriceps force (3%) and activation (5%). The other interventions did not demonstrate this effect. **Conclusions/Clinical Relevance:** Following lumbopelvic joint manipulation there was an immediate increase in quadriceps force output and activation. The mechanism for increased quadriceps force output following lumbopelvic manipulation was increased quadriceps motoneuron pool excitability as demonstrated by the increase in quadriceps CAR. The window of effectiveness was less than 20 minutes in healthy individuals. Force output steadily decreased over the 60-minute testing session for all groups. The mechanism for decreased force output was unknown. These findings support the use of a lumbopelvic joint manipulation to increase quadriceps strength and activation in healthy individuals, but these effects diminish within 20 minutes. Further research is necessary to determine magnitude and duration of change in individuals with lower extremity joint pathology.

INTERTESTER RELIABILITY OF EXAMINERS CLASSIFYING LOW BACK PAIN PROBLEMS BASED ON THE MOVEMENT SYSTEM IMPAIRMENT CLASSIFICATION SYSTEM

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Purpose: Classification of patients with low back pain (LBP) based on relevant variables may be important for improving clinical outcomes and research efficiency. A standardized examination based on the Movement System Impairment (MSI) classification system has been developed to classify patients with LBP. The 5 proposed MSI classifications are based on the most consistent patterns of movement and alignment that are observed throughout the examination and that correlate with the patient's symptom behavior. The purpose of this study was to examine the inter-tester reliability of 2 trained physical therapists to classify patients with LBP using the MSI system standardized clinical examination. **Methods:** 22 subjects with chronic, recurrent LBP (mean age 28.9 ± 10.2 ; 16F/6M) were examined independently by 2 experienced physical therapists. Each therapist had greater than 10 years experience in treating musculoskeletal conditions. The first author was a board-certified clinical specialist in orthopaedic physical therapy. The second author developed the standardized examination used for the current study. The second author trained the first author in the test procedures, operational definitions and rules for classification. Training consisted of self-study of a procedure manual, practice in the use of the examination technique and classification rules, and discussion. Each therapist examined subjects independently using a test-retest design. Both therapists examined each subject on the same day with a 15-minute break between examinations. The order in which the therapists performed the examination was determined by convenience of the therapists' schedules. During the first session, each subject completed a set of self-report forms, answered a set of history questions, and participated in the physical examination. While the subject rested the first therapist reviewed the self-report and

history information with the second therapist. The second therapist then performed the physical examination. Each therapist assigned a LBP classification upon completion of the examination. Both therapists were blinded to the other therapist's findings. Inter-tester reliability of therapists classifying the LBP problems was indexed by the percent agreement and weighted kappa coefficient. **Results:** The first author performed the first examination in 13 of the 22 (59%) examinations. Repeated examinations did not increase the patient's LBP. The inter-tester reliability of classification was excellent. Overall agreement on the classification assigned was 95% with $\kappa=0.89$. **Conclusion/ Clinical Relevance:** Inter-tester reliability of classification of patients with LBP using a standardized clinical examination based on the MSI classification system is excellent. Classification of patients with LBP may contribute to improved clinical outcomes and research efficiency. The current study demonstrates that experienced physical therapists trained in a standardized examination based on the principles of MSI classification system can determine the LBP classification reliably. Future work will focus on training and testing the reliability of novice examiners to classify LBP problems based on the MSI system.

PREVALENCE OF THORACIC SPINE AND RIB CAGE DYSFUNCTION AMONG RUNNERS WITH AND WITHOUT EXERCISE-RELATED TRANSIENT ABDOMINAL PAIN

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Purpose: The purpose of this investigation was to determine if the prevalence of thoracic spine and rib cage dysfunction is greater in runners with exercise-related transient abdominal pain (ETAP) compared to controls. ETAP, also known as "stitch", is a common condition among runners (69%) with a poorly understood etiology. Recent work has suggested that movement dysfunction of the thoracic spine or rib cage joints may be a mechanism for ETAP in runners as the repetitive torso movement during running can result in a stress irritation to adjacent structures, including the intercostal nerves that innervate the anterior abdominal region soft tissues. Characterizing the relationship between ETAP and joint dysfunctions of the thoracic spine and rib cage will be useful in determining appropriate orthopedic manual techniques that can be employed by the physical therapist to prevent or manage ETAP symptoms. **Subjects:** 37 subjects have been assessed using the single-blind (examiner), case-control design, with a target enrollment of 80 subjects. All subjects were required to be in good health and run a minimum of 8 miles/wk. Subjects were divided into three groups based on the frequency of ETAP symptoms during running in the previous six months: 1) monthly occurrence ($n=7$; 3 males); 2) less than monthly occurrence ($n=15$; 7 males); and 3) no occurrence ($n=15$; 4 males). **Methods:** All subjects ran for at least 30 min within the 2 hrs preceding their scheduled data collection session and avoided eating or drinking anything other than water within this same time period. A standardized examination of the thoracic

spine and rib cage was performed on each subject by two experienced physical therapists with advanced training in spine manual therapy. Posterior-to-anterior pressures were applied to the spinous processes and transverse processes of C7-T12 with the subject in prone as well as to the posterior rib angles (Ribs 1-12), and to the anterior costosternal joints (Ribs 1-7) with the subject in supine. Mobility of each examined joint was assessed as hypomobile, hypermobile, or normal, with pain provocation rated on a 0-10 scale with 0 being no pain. Using an expanded definition of agreement (e.g., ± 1 spinal level), κ -statistics were used to determine the inter- and intra-examiner reliability. The prevalence of thoracic spine and rib cage dysfunction and pain provocation were calculated on a per subject basis for each group. A comparison of the prevalence of thoracic spine and rib cage dysfunction and pain provocation between the three groups was performed using a χ^2 -analysis. **Results:** Intra-examiner reliability of joint mobility assessment ($\kappa=0.65-0.71$) and pain provocation ($\kappa=0.75-0.91$) for both examiners was good, while inter-examiner reliability for joint mobility ($\kappa=0.50$) and pain provocation ($\kappa=0.28$) was fair to poor, respectively. The presence of joint mobility dysfunction was consistent between groups (thoracic spine, $\chi^2=1.51$, $P=0.47$; rib cage, $\chi^2=3.92$, $P=0.14$), with thoracic spine prevalence greater than 90% and rib cage prevalence greater than 70%. Over 50% of subjects with monthly ETAP reported pain during joint mobility assessment compared to 25% of subjects with less than monthly ETAP and 15% of control subjects (thoracic spine, $\chi^2=2.93$, $P=0.23$; rib cage, $\chi^2=3.99$, $P=0.14$). **Conclusions/Clinical Relevance:** The presence of joint mobility dysfunction in the thoracic spine or rib cage does not appear to have a greater occurrence among runners that experience ETAP. However, these preliminary results indicate that pain provocation during joint mobility assessment may be more frequent among runners with ETAP. ETAP frequently has negative consequences on exercise participation and athletic performance, resulting in either a reduction in intensity or a total cessation of activity. Orthopedic manual interventions designed to reduce mild joint pain may limit the occurrence of ETAP among runners and those beginning an exercise program involving running, thereby improving their quality of life and exercise program adherence.

SUBJECTS WITH CHRONIC LOW BACK PAIN IN SYMPTOM REMISSION DO NOT DEMONSTRATE DEFICITS IN PROPRIOCEPTION

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Purpose: Subjects with chronic low back pain (CLBP) have been shown to demonstrate deficits in proprioception. Subjects with CLBP who are currently in symptom remission have been noted to demonstrate deficits in neuromuscular control. The literature typically reports mean pain levels at the time of proprioception testing but does not usually stratify results based on pain level including subjects who have no pain at the time testing. The purpose of this study was to examine subjects with CLBP who are in symptom remission and determine if they demonstrate proprioception deficits. **Subjects:** 50 subjects, 33 with CLBP and 17 controls agreed to be examined for trunk proprioception. **Methods:** Trunk proprioception was measured using a Biodex Systems 3 with a sagittal plane trunk attachment. Proprioception was measured through joint position sense (JPS), threshold to detect passive motion (TTDPM), and force reproduction (FR). The first testing session of a more comprehensive RCT was examined to determine if any difference was noted between the subjects with CLBP, who were currently pain free and subjects with no history of CLBP. Six trials of JPS and TTDPM and 5 trials of FR were performed during each testing session. Mean error rates for each proprioception submodality were compared. Subjects with CLBP were randomized into two treatment groups with $n=17$ for group A and $n=16$ for group B. For the purpose of this analysis, those two CLBP groups were compared to the control group ($n=17$) using a one-way ANOVA with significance set at $\alpha = 0.05$. Tukey post-hoc analyses were used to determine where significance was found when the omnibus analysis was significant. **Results:** No statistically significant difference was noted for JPS or FR with $P=0.325$ and 0.839 , respectively. For TTDPM, significance was noted between groups with $P=0.035$. Post-hoc analysis demonstrated the difference was between the CLBP groups A and B with $P=0.030$. No differences were noted between either of the CLBP groups compared with the control group. **Conclusion/Clinical Relevance:** These data suggest that there are no differences between subjects with CLBP who are currently in symptom remission and subjects without CLBP. These results may conflict with literature suggesting subjects with CLBP demonstrate proprioception deficits and subjects with CLBP in symptom remission have neuromuscular control deficits. However, it is also possible that these results further refine previous literature implying that pain is the cause of proprioception deficits and that in symptom-free CLBP, proprioception and neuromuscular control are not that strongly correlated. Clinically, when treating subjects without LBP, proprioception may not be a primary goal. This may be important in treatment progression over the course of care as symptom dominance diminishes during the functional retraining phase of rehabilitation.

CASE REPORT: BILATERAL PEDICLE FRACTURE OF ATLANTOAXIAL JOINT SENSED BY SHARP-PURSER TEST

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Purpose: The Sharp-Purser test was first used to detect instability of the atlanto-axial(AA) joint of rheumatological patients. It has been one of the few manual tests that have demonstrated 96% specificity and 88% sensitivity for AA instability. In this case report, the Sharp-Purser test was used to detect instability of the AA joint caused by a bilateral pedicle fracture. This may be the first time this test has detected a fracture of the axis. **Subject:** An 84-year-old female was in a motor vehicle accident (MVA) with a head-on collision. **Methods:** She was evaluated using the NEXUS rules and it was determined that there was no significant pathology present. She was then referred for physical therapy, where a differential diagnosis exam was initiated. Due to the unwillingness to turn her head, great caution was taken even when the NEXUS rules were satisfied. With further subjective questioning there were no significant indications of pathologies present that would contraindicate manual examination. Due to limited active range of motion (ROM) present, stability screening was implemented to ensure safety with treatment. The Sharp-Purser test was utilized first to rule out any instability that would not be detected with NEXUS rules. **Results:** There was increased motion detected with no increase of neurological signs. The test was considered positive and the patient was returned to the physician for further evaluation. She was followed up with functional flexion and extension X-rays demonstrating a bilateral pedicle fracture. **Conclusion/Clinical Relevance:** Although this test has not been used previously to detect fractures and is not advocated for that purpose, it was able to detect a fracture when normal radiographs were present. This report demonstrates the importance of differential diagnosis and relying on specific and sensitive testing to ensure the safety of the patient while properly diagnosing the pathology.

ARE ACUTE, CHRONIC, BACK PAIN-ONLY, AND SCIATICA-WITH-NEURAL-DEFICIT VALID LOW BACK PAIN SUBGROUPS? NOT FOR MOST PATIENTS

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Purpose: Acute and chronic low back pain (LBP), as well as LBP-only and sciatica with neural deficit, are all often considered very different disorders needing different treatments with greatly different recovery and cost expectations. The purpose of the current analysis is to evaluate the value of sub-grouping patients based on pain duration and Quebec Task Force (QTF) pain location/neural status categories. **Subjects:** 80 patients with LBP found at baseline to have a directional preference, who were then treated with match-

ing directional exercises. **Methods:** During patient intake for a previous report randomized clinical trial (RCT), patients were categorized as having acute, sub-acute, or chronic LBP and also by QTF categories 1-4, ranging from LBP-only to sciatica with neural deficit. Prior to randomization, the pain of 74% of 312 consecutive patients reduced, centralized, or abolished with a single direction of repeated end-range testing referred to as a patient's "directional preference" (DP). This is a secondary analysis of the eighty DP patients, who received exercises matching their DP. Outcome measures included back and leg pain intensity, activity interference, Roland-Morris Disability Questionnaire, medication use, Beck Depression Inventory, and self-rated improvement. General linear modeling analyses were used to evaluate the effects of pain duration and QTF pain location/neural category on seven outcome measures after two weeks of treatment for the 71 of the 80 DP patients treated with "matching" directional exercises, who had completed two weeks of treatment. **Results:** Although there was significant improvement after two weeks of treatment for all seven outcome measures, differences in outcomes after two weeks of care after adjusting for baseline differences were not well predicted by QTF categories 1-4 or pain duration. No significant differences were reported for any of the seven outcome variables across QTF 1-4 location/neural subgroups or in five of the seven across the three duration subgroups at the end of treatment. Chronic patients reported substantial reduction in back pain intensity but significantly less than acute patients ($P<0.005$). Complete resolution of symptoms was reported for 81.8% of acute, compared to 44.4% of sub-acute and 30.3% of chronic patients ($P<0.011$). **Conclusions/ Clinical Relevance:** When DP patients were treated with directionally-matching exercise treatment, classifying patients by their QTF 1-4 pain location/neural status or their pain duration did not predict 12 of 14 outcomes. Despite anticipated differences in outcomes by symptom duration, rates of improvement and recovery in acute, chronic, and sciatica-with-neural-deficit patients were far higher than expected with just two weeks of treatment. The clinical finding of DP appears to be a useful and reliable baseline indicator of a reversible characteristic of a pain-generator common to a large percentage of patients with acute, sub-acute, and chronic LBP and sciatica, even with neural deficit. This challenges the convention that these subgroups require separate assessment or treatment pathways as portrayed in current guidelines.

EXERCISE PRESCRIPTION FOR LOW BACK PAIN: A PROSPECTIVE PRAGMATIC SEQUENTIAL CASE SERIES FOLLOWING A RANDOMIZED CLINICAL TRIAL

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Purpose: To determine if outcomes can be changed following initial poor response to exercise therapy when patients are crossed-over to alternative exercises. **Subjects:** This cohort of subjects was selected from 312 subjects who consented to participate in a previously pub-

lished multi-center randomized clinical trial (RCT). Patients with low back pain (LBP) with or without leg pain were randomized into treatment interventions that were matched or unmatched to baseline directional preference/centralization subgroups. Eleven outpatient physical therapy facilities in 5 countries participated (including 5 in the USA). **Methods:** Prospective pragmatic sequential case series following RCT: In compliance with Ethic's Board recommendations, the inclusion criteria consisted of those subjects, who reported that their back pain problem was worse or unchanged after participation in the RCT. These subjects formed the cohort for the current series and were offered alternate care following the RCT. The sequence of data collection included 3 data points: baseline, after a maximum of 2 weeks participation in the original RCT, and after a maximum of a further 2 weeks of alternate cross-over care. Ninety-six subjects met the inclusion criteria and consented to participate in this second phase of treatment. Analysis included ANOVA and McNemar tests to compare outcomes during two chronological intervals. Fourteen dropouts were included in the intention-to-treat analysis based on carry-forward of last known data point. **Results:** 14 of 80 subjects from the matched group met entry criteria, but due to onward medical referral (persistent neurological deficits) and lack of consent, numbers were too small for statistical analysis. Ninety-six subjects from the two unmatched groups (N=62 and 69, respectively) met entry criteria of which 82 completed a 2-week crossover trial into matched treatment. There was a mean of 4 visits (range 1-6) in each phase of treatment. With mean episode duration of 42.4 weeks, these subjects served as their own control after crossover. Following the change to matched exercises there were statistically significant and clinically meaningful changes in 5 of 7 outcomes ($P < 0.001$). Those reporting improvement or resolution of symptoms increased from 22% to 84%. **Conclusions/Clinical Relevance:** Unfavorable outcomes resulting from nonspecific/unmatched exercise protocols appear to become favorable if subjects are crossed-over to direction-specific exercises. This series adds to the growing body of evidence supporting a role for specific exercises in the care of back pain and/or sciatica patients. Failure to respond rapidly to a general nonspecific exercise program does not indicate unresponsiveness to all exercise. It appears that changing the exercise prescription to one based on the individual patient's directional preference can favorably alter the course of recovery and improve outcomes.

DOES TEMPOROMANDIBULAR JOINT DISORDER INFLUENCE HEAD AND NECK POSTURE AND COORDINATION AT REST AND WITH WALKING TASKS?

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Purpose: Temporomandibular joint disorder (TMD) is a musculoskeletal disorder that has been clinically associated with forward head posture. Postural changes do alter the resting position of the

mandibular condyle in the temporal fossa and influence the mobility of the mandible during opening and closing tasks. In addition, walking velocity affects head and neck posture. The purpose of this study was to determine if subjects with TMD have greater forward head posture in resting upright standing and to see if coordination of the head and neck movements during manipulated walking speeds differ from healthy controls. **Methods:** 8 subjects with TMD and 8 healthy matched controls were recruited for this study. Using a 3D Motion analysis system head and neck positions were captured at rest and during a systematic manipulation of treadmill walking speed. Applying Matlab software the following angles were calculated: 1. Neck Angle from the vector formed by the C7 spinous process and the external auditory meatus and the horizontal; 2. Head Angle from the external auditory meatus and the zygomatic arch and the horizontal; 3. Total Head Neck Angle from the angle formed by these vectors. Data was analyzed using a between-group ANOVA with repeated measures with 1 within-group factor (Velocity: 6 levels) and 1 between-group factor (Group: TMD, healthy controls). **Results:** No statistically significant main effect for Group was found for Head Angle, Neck Angle, or Total Head Neck Angle position measurement in standing upright posture. In addition, no significant main effect for Group was obtained for angle position or angle amplitude. There was a significant main effect of Velocity for Neck Angle amplitude ($F_{2,15} = 7.431$; $P = 0.000$) and a significant interaction effect between Group and Velocity for the amplitude of the Total Head Neck Angle ($F_{2,15} = 6.423$; $P = 0.024$). As velocity increased the amplitude of the Neck Angle reduced for all subjects. The variability of the Total Head Neck Angle was reduced in the subjects with TMD compared to healthy controls at higher walking speeds. Post-hoc simple contrast analysis of Group differences at individual speeds showed only significant differences at a velocity of 1.5m/s ($t = 2.438$; $P = 0.029$; 95% confidence interval 0.84-1.31). **Conclusion/Clinical Relevance:** The findings of the present study do not support the clinical observation of forward head posture in subjects with TMD. Perhaps the differences observed in this population may be due to limited control of head and neck postural flexibility. Clinical examination of muscular performance of cervical stability should be included when evaluating subjects complaining of symptoms associated with TMD that appear to have postural abnormalities.

COMPARISON OF A CONVENTIONAL PATELLOFEMORAL JOINT EXERCISE PROGRAM VERSUS A MANUAL THERAPY APPROACH FOR MANAGING ATYPICAL ANTERIOR KNEE PAIN: A PROSPECTIVE, SINGLE-SUBJECT CLINICAL TRIAL

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Purpose: Anterior knee pain is a common condition encountered by clinicians on a daily basis. This term is used to categorize a host of knee conditions related to the anterior knee. **Subject:** We present a

single subject design involving a 36-year-old female, who presented with atypical anterior knee pain. We defined atypical anterior knee pain as negative patellofemoral joint test, provocative passive knee extension, and positive Steinmann II test. These examination findings suggested a structure other than the patellofemoral joint as the potential pain generator. **Methods:** During the exercise intervention phase she was treated unsuccessfully with a previously published patellofemoral joint protocol that represents the contemporary standard of practice. The final treatment phase involved joint-specific mobilization aimed at restoring pain-free passive knee extension and meniscal movement. **Results:** The patient demonstrated significant improvements with the joint-specific mobilization phase but not after the previous exercise treatment phase, as evidenced by a reduction in knee pain and increased function. **Conclusion/Clinical Relevance:** We suggest that joint-specific mobilization may serve in the successful management of patients with similar anterior knee pain who present with atypical examination findings.

MANUAL PHYSICAL THERAPY INTERVENTION FOR AN INVERSION ANKLE SPRAIN: A CASE REPORT.

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Purpose: The purpose of this case report is to describe the outcomes of a patient with persistent pain, restricted motion, and decreased function of the right ankle treated with manual physical therapy (MPT) and exercise. **Subject:** The patient was a 21-year-old female, who reported sustaining an inversion sprain of her right ankle nine weeks prior to the initial physical therapy examination. Her chief report was antero-lateral ankle pain exacerbated by running and jumping activities. Key physical impairments identified during the examination included hypomobility of the talocrural joint, limited ankle dorsiflexion, swelling, and impaired stork standing with the eyes closed. **Methods:** The patient was treated for 7 visits over a 5-week period. MPT interventions included non-thrust mobilization of the talocrural joint. Therapeutic exercises included balance retraining. Additionally, interferential current was used for one session for the management of edema. Outcome measurements, including the Lower Extremity Functional Scale (LEFS), Numerical Rating of Pain Scale (NPRS), and the Patient Specific Functional Scale (PSFS), as well as active and passive range of motion measurements (AROM/PROM), were recorded at the initial examination, and at 5, 14, 22 days as well as at the time of discharge from physical therapy. **Results:** The patient exhibited dramatic improvement between the time of the initial examination and discharge from physical therapy. The LEFS score improved from 70/80 at baseline to 78/80, nine days prior to discharge. The PSFS improved to 10/10 in all three functional tasks. The three functional tasks at baseline were: a 9/10 with falling asleep; 6/10 for walking on uneven surfaces; and 4/10 for running and jumping. The NPRS

for pain at its worst was a 6/10 at baseline and 0/10 at discharge. Dorsiflexion AROM/PROM improved from 8/12° at the initial examination to 22/25° at discharge. **Conclusion/Clinical Relevance:** MPT interventions, exercise, and edema management directed at the ankle may have resulted in decreased pain and improved functional disability in a patient presenting with an inversion ankle sprain. In addition, the patient's ankle range of motion changes occurred without any gastrocnemius muscle stretching. With a case report we cannot infer causal relationships; however, this case report is consistent with two recent articles supporting the use of MPT to improve ankle function and range of motion following a lateral ankle sprain. Further research is necessary to determine which subgroup of patients with limited ankle mobility would benefit from MPT interventions and exercise targeted at the talocrural joint.

SUPRASCAPULAR NERVE ENTRAPMENT AT THE SPINOGLENOID NOTCH: A CASE REPORT

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Purpose: This case study describes suprascapular nerve entrapment at the spinoglenoid notch and the effectiveness of its conservative management. Reported incidence of suprascapular nerve entrapment is rare at approximately 0.4% in a series of 2,520 patients with shoulder pain. Literature on management of suprascapular nerve entrapment describes surgical intervention with no conservative emphasis. **Subject:** A 54-year-old Caucasian male presented with severe right shoulder pain, weakness, and muscle atrophy. Initial medical referral suggested rotator cuff syndrome with inconclusive imaging. Findings were negative for impingement and a capsular pattern of restriction. **Methods:** Further examination revealed reproducible pain at the spinoglenoid notch with weakness of shoulder abduction and external rotation grade 2+/5. Conservative management included neural interface mobilization at the fibro-osseous tunnel of the spinoglenoid notch, scapular stabilization exercises, upper extremity strengthening, and pain modalities. **Results:** Reduction of pain was observed in 2 weeks and returned to work with limitations in 4 weeks. The patient was discharged with a home exercise program by week 7. A 6-month and 2 year follow-up revealed symptom-free return to work status. **Conclusion/Clinical Relevance:** Entrapment of suprascapular nerve at the spinoglenoid notch with subsequent adverse neural tension is described as the symptom source. A positive outcome with conservative management poses relevance to appropriate physical therapy intervention. Further studies on the effectiveness of conservative care of suprascapular nerve entrapment versus surgical intervention are warranted.

THE EFFECT OF USING A VIDEOFLUOROSCOPIC TEACHING INSTRUMENT TO IMPROVE KNOWLEDGE OF UPPER CERVICAL FUNCTIONAL BIOMECHANICS

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Purpose: To evaluate the effect of the videofluoroscopic teaching instrument (VTI) on improving knowledge of upper cervical spine functional biomechanics for physical therapists. **Subjects:** Subjects were taken from three cohorts who attended the same continuing education seminar at three different times and locations. Cohort one consisted of 11 physical therapists, cohort two consisted of 23 physical therapy students, and cohort three consisted of 17 physical therapists. **Methods:** Cohort 1 was used to develop a 17-question test that served as a measurement tool for cohorts two and three. Cohort two was used to measure knowledge of the upper cervical spine functional biomechanics when the traditional method of teaching was used. Cohort three was divided into a control group and an experimental group to assess the effect of the VTI. The pre-test/post-test data collected on cohort 1 was used for analysis of variance (ANOVA) to evaluate the relationship between cohort two and cohort three. A within-group ANOVA of cohort three was completed to evaluate the effect of the VTI on improving knowledge for physical therapists and comparing it to the traditional teaching methodology alone. A power analysis was conducted to determine the effect of the VTI. For a one-tailed test with alpha level set at 0.05, the calculated power was 0.401. It was further determined that 26 subjects (13 in experimental and 13 in control group) would be necessary to achieve sufficient power. **Results:** The test results of cohort two were compared to cohort three, who used the VTI during the same continuing education seminar. Statistical analysis found no significant difference between the two groups. Cohort three data from the pre-test and post-test 17-question examination showed no statistical difference between experimental and control groups. The experimental group did show improved post-test scores overall but due to the lack of subjects, the difference was not statistically significant. **Conclusion/Clinical Relevance:** There was no statistically significant difference when a VTI was used to teach physical therapists upper cervical spine functional biomechanics. Feedback from seminar participants indicated that the VTI was valuable for understanding the functional biomechanics of the upper cervical spine. More research is needed to examine the effect of knowledge gained from traditional teaching methods compared to knowledge gained from advanced teaching methods using imaging technologies. The upper cervical spine functional biomechanics are difficult to understand. Physical therapists that do not understand this area may have difficulty with clinical examination and intervention skills. Developing new teaching methods using advanced real-time imaging technologies may increase knowledge of the upper cervical spine functional biomechanics. Continuing education seminar instructors have the responsibility of researching the effectiveness of their teaching, teaching instruments, and clinical techniques.

MANAGEMENT OF A PATIENT STATUS-POST ANTERIOR CAPSULAR SHIFT USING PROGRESSIVE EXERCISE AND MANUAL PHYSICAL THERAPY

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Purpose: To describe the clinical decision-making process and manual physical therapy management status-post anterior stabilization surgery for a patient with multidirectional instability of the shoulder. **Subject:** A 21-year-old female college senior, who had experienced her first left shoulder dislocation at the age of 11 while playing softball. Since then she had experienced repeated subluxation with activities, primarily swimming and softball, leading up to an open left shoulder anterior capsular shift procedure for diagnosed multidirectional instability. **Methods:** The patient was treated for 18 visits over 12 weeks, initiating physical therapy 30 days following surgical intervention. Physical therapy interventions included progressive passive range of motion, active assisted range of motion, rotator cuff and scapular musculature progressive resisted exercise, proprioceptive, and plyometric training. At visit 11, 7 weeks following surgery, the patient continued to struggle to regain her end range motion for both abduction and flexion range of motion due to sharp subacromial pain. Based on further clinical assessment, a program including thrust manipulation of the mid-thoracic spine, non-thrust mobilization using muscle energy techniques for the left sternoclavicular and acromioclavicular joints and grade 3 inferiorly directed glenohumeral joint mobilization was implemented for two visits only. Outcome measures included Numeric Pain Rating Scale (NPRS) weekly and the Disability of the Arm, Shoulder and Hand (DASH) functional measure at discharge and 9 month follow-up from physical therapy. **Results:** The NPRS was 5 at baseline and improved to a 0-1 with mild soreness at 3 months and 0 at 9-month follow-up. The DASH was 46.6 at baseline, improved to 7.5 and 3.3 at 3 and 9 months, respectively, well within the minimally important difference of 10 points. Following manual physical therapy intervention, the patient improved from 100 to 175° of flexion and from 95 to 165° of abduction in one week and was able to more assertively progress with her active strength and conditioning program. Sports and work modules of the DASH demonstrated improvement as well. **Conclusion/Clinical Relevance:** Manual physical therapy to the thoracic spine and shoulder girdle complex may be helpful in increasing ROM, decreasing pain, and improving function in individuals' status-post surgical anterior stabilization for shoulder instability. Larger case series and further research to identify the potential value of manual physical therapy for these patients is indicated. Shoulder instability requiring surgical intervention is typically managed with disciplined exercise-based protocols. A review of the peer-reviewed literature revealed no description of manual physical therapy management for patients with this condition. This case study suggests that manual physical therapy interventions may play a useful role in facilitating a positive clinical outcome.

THE SHORT-TERM EFFECTS OF MANUAL PHYSICAL THERAPY, MAXILLARY SPLINTING, AND EXERCISE FOLLOWING TRAUMATIC TEMPOROMANDIBULAR JOINT INJURY

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Purpose: The objective of this case series is to report the short-term effects of manual physical therapy (MPT), maxillary splinting, and exercise following traumatic temporomandibular joint (TMJ) injury. TMJ symptoms are a common finding in patients with hyperextension or hyperflexion injuries of the cervical spine. To date, there is a paucity of research describing the effects of MPT on traumatic TMJ injury. **Subjects:** Case series of four subjects, including one male and three females, age ranging from 32-54 years. Motor Vehicle Accident (MVA) was the reported method of injury in three cases, and one patient was injured while cycling. Common clinical findings included: forward head posture, headache, positive pain mapping of the TMJ, limited cervical, thoracic and TMJ mobility, increased muscle tone of the cranio-cervical region, and altered mechanics of the TMJ. **Methods:** All subjects completed a Neck Disability Index (NDI) and Numerical Pain Rating Scale (NPRS) at baseline and discharge. The number of attended visits ranged from 2-21, over a 1 to 18 week time period. All subjects received MPT to the TMJ, cervical and thoracic spine, resting maxillary splints via referral, intra or extra-oral soft tissue mobilization, stabilization training to the cervical spine and periscapular region, and a structured home program. Descriptive statistics were completed on health outcome scales. **Results:** Baseline NDI ranged from 24%-72% and NPRS ranged from 7-10. At discharge each subject reported clinically important functional improvements, with improvements in their NDI scores ranging from 10-72 points and improvements in their NPRS scores ranging from 2-10 points. The improvements for each patient exceeded the established thresholds for minimally clinically important differences for both the NDI and the NPRS. **Conclusions/Clinical Relevance:** This case series presents preliminary evidence supporting the utilization of MPT, resting maxillary splinting, and exercise in the management of traumatic TMJ injury. While a case series cannot prove cause and effect, this case series does provide initial data to guide future research. For individuals suffering traumatic TMJ, MPT interventions targeting impairments in the cervico-thoracic, periscapular, and TMJ regions, in combination with exercise and maxillary splinting, should be considered as part of the primary treatment plan.

MANUAL PHYSICAL THERAPY APPROACH TO TREATMENT OF THORACIC OUTLET SYNDROME: A CASE REPORT

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Purpose: To describe the examination, manual physical therapy interventions, and clinical decision making for a patient with thoracic outlet syndrome (TOS). No published literature has been found that describes the use of a manual physical therapy approach with thrust or non-thrust manipulation to the cervical and thoracic region in the management of TOS. **Subject:** A 22-year-old female presented to physical therapy with a primary complaint of insidious onset right wrist and hand pain. Secondary complaints included paraesthesiae in the hand and forearm as well as muscle tension in the cervical region. **Methods:** Physical therapy examination was positive for TOS as evidenced by Allen, Adson, and Roos tests. Cervical radiculopathy was ruled out and the shoulder and wrist were free of impairment. Neck Disability Index (NDI) and Disabilities of the Arm Shoulder and Hand (DASH) scores were 48 and 52 respectively, while the numeric pain rating scale (NPRS) was 7/10. Primary interventions included thrust manipulation to the cervico-thoracic and middle thoracic spine, non-thrust manipulation to the cervical spine, and therapeutic exercise for the cervical and thoracic regions. **Results:** There was a complete resolution of symptoms and special tests following 3 treatments in 2 weeks. DASH score and NPRS were both 0, while the NDI was 2%. Symptom resolution persisted at the 3-month follow-up. **Conclusion/ Clinical Relevance:** The manual physical therapy interventions to the cervico-thoracic and thoracic region described in this case report were effective in resolving symptoms associated with TOS. This case report is the first to describe a manual physical therapy approach for a patient with TOS. The treatment outlined in the present case may benefit other patients with a similar presentation.

MANAGEMENT OF LOWER EXTREMITY IMPAIRMENTS IN A FEMALE COLLEGIATE ATHLETE WITH LOW BACK PAIN: A CASE REPORT

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Purpose: 50-80% of the population will experience low back pain (LBP). Evidence related to the contribution of lower extremity impairments to the onset of LBP is inconclusive. The purpose of this case report is to discuss the interdependency between the lower extremity and the lumbar spine, provide evidence for the relationship between impairments of the lower extremity and the presence of LBP, and to describe the use of a multimodal approach to intervention that includes both manual and non-manual procedures. **Subject:** The subject was a 21-year-old, female athlete in her senior year

of participation in intercollegiate basketball and lacrosse with chief complaint of LBP that restricted her athletic participation. Examination revealed a multitude of lower extremity structural and functional impairments. **Methods/Results:** Each impairment was systematically addressed through a multimodal intervention approach that utilized manual therapy, exercise, and extrinsic accommodations leading to the favorable outcome of return to full sport participation. During the symptom control phase, modalities, mobilization with movement of the spine and hips, hamstring stretching using Mulligan straight leg raise (SLR) with distraction, and transverse abdominis exercises were employed. On visit 4, the patient presented noting no LBP for the first time in many months. Furthermore, her SLR had improved bilaterally by 20°. During the return to modified activity phase, running was introduced with arch support and the patient returned to limited sport participation. Symptoms were localized to the left sacroiliac joint (SIJ) with pelvic positional asymmetries that were addressed through manual intervention. The return to full activity phase included implementation of custom-molded orthotics. During this phase, pain rated at 2/10 was noted over the left SIJ only. Thirteen weeks after her initial examination, complete resolution of her original complaints was

noted and she returned to full athletic participation, which was maintained at 2-month follow-up. She had an ODQ score of 4% at discharge and 2% at 2-month follow-up respectively compared with 6% at the time of her initial examination. **Conclusion/Clinical Relevance:** In the context of intercollegiate athletics, a combination of lower extremity impairments served as antecedent contributors to this patient's chief complaint, thus limiting her athletic participation. To reduce her LBP and to facilitate return to athletics, these impairments were comprehensively addressed. This case report demonstrates the importance of appreciating the functional interrelationship of the lower quarter through incorporating manual and non-manual interventions directed toward the resolution of lower extremity impairments in the management of LBP. An appreciation for the impact that structural and functional lower extremity impairments have on the pathogenesis of LBP is not well understood and not routinely considered in the clinic. Clinicians should appreciate the functional relationships of the lower quarter and consider the contribution of lower extremity impairments in the management of individuals with LBP.
