ABSTRACTS

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EXAGGERATED FLEXOR WITHDRAWAL REFLEXES ARE NOT MODULATED BY SPINAL THRUST MANIPULATION IN INDIVIDUALS WITH KNEE OSTEOARTHRITIS

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Relevance and Purpose: While several studies have demonstrated the clinical effectiveness of spinal manipulation in the treatment of musculoskeletal dysfunction, much less is known about the neurophysiological mechanisms mediating these results. Previous work has demonstrated increased excitability of the pain pathways in subjects with knee osteoarthritis (OA), which was diminished following graded oscillatory joint mobilization. The aim of the present study was to investigate the potential effect of spinal high velocity low amplitude (HVLA) thrust manipulation on this reflex in individuals with knee OA. **Subjects:** Ten subjects with and ten without knee osteoarthritis (age 53-74) were recruited. **Methods and Analysis:** Pain levels at the knee were recorded prior to and throughout each stage of testing using a visual analog scale (VAS). Sensory threshold to the electrocutaneous stimulation was recorded. 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 and biceps femoris. Noxious electrocutaneous stimulation was applied at the medial arch of the foot (monophasic, 10 pulses, 1 ms duration, 200 Hz) at 1X and 2X threshold of tibialis anterior EMG response. Joint torques at hip, knee and ankle were calculated, with peak reflex torques normalized to body mass. Three trials were collected at 2X threshold and following 1) sham lumbar thrust manipulation and 2) a HVLA thrust lumbar rotation manipulation localized to lumbar segmental level L3-4. EMG and joint torques were normalized to baseline responses at 2X threshold and compared using t-tests. In a subgroup of subjects with OA (final 5 consecutive subjects), FWR was tested (successive to the lumbar manipulation condition) following a bout of Grade III oscillatory knee mobilization (2 X 3 min) and in 5 min intervals to assess for longevity of the response modulation. **Results:** Average pain prior to testing (VAS) in the OA group: 3.9 ± 2.1; following lumbar manipulation: 3.4 ± 1.9 (p=0.41), and following knee mobilization 2.3 ± 2.3 (p=0.09). Sensory threshold was increased in the OA group (3.2 ± 1.2 mA) vs. control group (2.4 ± 0.7 mA; p = 0.08). Decreased threshold to flexor withdrawal response was found in the osteoarthritis group (OA = 10.9 ± 3.9 mA; control = 15.5 ± 2.2; p = 0.04) indicating increased excitability of the pain pathways. In the OA group, no differences in FWR responses were demonstrated post-sham treatment or post-lumbar thrust rotation manipulation (p=0.26), but were diminished significantly post-knee mobilization (p=0.04). Gradual increase in FWR response occurred over the 3 X 5 minute intervals following knee joint mobilization and was not significantly different from baseline at 15 minutes post intervention (p=0.28). **Conclusions and Implications:** Non-thrust manipulation techniques at the knee appear to cause a short-term inhibitory effect on flexor responses. In contrast, L3-4 HVLA thrust techniques had less effect and may be a less effective manual treatment for the treatment of chronic knee osteoarthritis.

ORTHOPEDIC MANUAL PHYSICAL THERAPY FELLOWSHIP TRAINING RESULTS IN IMPROVED CLINICAL OUTCOMES IN MODIFIED LOW BACK PAIN DISABILITY QUESTIONNAIRE: PRELIMINARY DATA

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Purpose: Advanced training in Orthopedic Manual Physical Therapy (OMPT) through a credentialed fellowship program is a rigorous and challenging experience with the expected result of improved patient outcomes and increased efficacy of practice. While each credentialed program has met educational standards devised to attain these goals, improved patient care outcomes have not been demonstrated in the research literature. The purpose of this study was to retrospectively examine the clinical outcomes data of a class of OMPT fellows enrolled in a one year, full time OMPT fellowship program by comparing first quarter results of the Modified Low Back Pain Disability Questionnaire (MLBPQ) scores in patients with low back pain (LBP) with results obtained in the 4th quarter of the program. **Subjects/Methods:** The four physical therapists in the program had an average of 9.25 years of experience (range 7-14 years) prior to beginning the fellowship program. Clinical outcome results for patients with low back pain evaluated with the MLBPQ were analyzed retrospectively for the time period of July 2007 through June 2008. Data was divided into quarter years based on the date of the initial visit and outcomes from the 1st quarter were compared with outcomes from the 4th quarter. Data was sampled equally from the four physical therapists. Demographic

characteristics were analyzed for each group. Point change in MLBPQ scores and change in pain scores (visual analog scale) were calculated comparing the 3rd visit to the initial visit. **Results:** Patients seen in the first quarter were 80% female with mean age of 49.1±21 years. The payer mix was 40% Medicare, 30% Medicaid, 20% HMO, and 10% PPO. Mean baseline MLBPQ scores were 42±27 points and mean VAS pain scores were 6.5±1.6. Patients seen in the 4th quarter were 63% female with mean age of 49.7±17 years. The payer mix was 19% Medicare, 31% Medicaid, 6% workers compensation, 6% self-pay, 19% HMO and 19% PPO. Mean baseline MLBPQ scores were 47±15 points and mean VAS pain scores were 5.9±1.9. Mean change in MLBPQ in the first quarter on the 3rd visit was 0.8±4.5, while in the 4th quarter, the mean change was significantly higher at 8.5±9.7; $p<0.01$. Mean VAS pain scores at 3rd visit showed greater improvement in the 4th quarter (1.8±2.9) as compared to the 1st quarter (0.3±2.0; $p=0.08$). **Conclusion:** Our preliminary data indicates that fellowship training may promote greater efficiency and effectiveness in treating low back pain. Future research into the factors which mediate improved clinical practice is indicated.

AN IMPAIRMENT BASED APPROACH TO THE TREATMENT OF NON-SPECIFIC ANTERIOR HIP PAIN: A CASE REPORT

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Purpose: This case report describes the successful management of a patient with a primary complaint of six-month duration anterior hip pain with secondary low back and groin pain. The case describes an impairment based treatment approach focused on manual physical therapy interventions. **Subject**: Subject was a 33 year old male reporting with a primary complaint of constant bilateral hip and groin pain right greater than left, and intermittent low back pain over the last six months. The onset occurred while sprinting and was initially thought to be an iliopsoas strain. However the pain became chronic and more widespread in nature. Sit to stand, straight leg raise and sitting up from a supine position exacerbated the anterior hip pain. Pain was bilateral and he was tender to palpation throughout both iliopsoas muscles, anterior hip joints, and over the pubis symphysis. Previous treatment included chiropractic care including manipulation, and aggressive massage to the iliopsoas muscles providing temporary relief. **Method**: Initial evaluation revealed limited hip flexion due to anterior hip pain, limited hip extension with tight iliopsoas muscles, and positive hip scour tests bilaterally. Hip abduction strength was 4/5 bilaterally. Adduction strength was 4-/5 and reproduced pubic pain. Standing lumbar flexion was limited, and end range flexion reproduced right lumbosacral. Posterior-to-anterior spring testing revealed hypomobility at all lumbar motion segments. Gait assessment revealed limited bilateral stride length with minimal hip extension bilaterally at terminal stance. Purposeful increased stride length reproduced anterior hip pain. The patient had exquisite tenderness over the pubic symphysis, and bilateral anterior hip joints right more than the left. Pain was reproduced with sitting-up and performing active straight leg raises. The Numeric Pain Rating Scale (NPRS) at rest was 5/10, worst 8/10, least 4/10. The Modified Low Back Pain Disability Questionnaire (OSW) score was 26%. Radiographs of both hips and the pelvis reported no bony defects. **Analyses:** It was hypothesized that an initial injury to the iliopsoas occurred resulting in muscle guarding and gait deviations. The resulting altered movement patterns created hip and lumbar spine hypomobility and shortening of the iliopsoas muscles leading to chronic pain. Other diagnostic concerns necessary to rule out were osteitis pubis and inguinal hernia. No pubic bone abnormalities were found on radiographs and inguinal tenderness was limited. An impairment based approach was implemented focusing on restoring hip and lumbar spine mobility, increasing hip strength, and normalizing his gait pattern. **Results**: The subject was treated for seven visits over a five-week period resulting in a complete resolution of symptoms (NPRS= 0; OSW=0%). Interventions included lumbar and hip mobilization/manipulation, manual muscle stretching, exercises to address hip weakness, and lumbar stabilization exercises. **Clinical Relevance:** In light of diagnostic uncertainty, an impairment based approach to the treatment of anterior hip pain can be effective in improving motion and strength and restoring function.

SAFE MANIPULATIVE PRACTICE IN THE CERVICAL SPINE: TOWARDS AN INTERNATIONAL STANDARD

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Purpose: The International Federation of Orthopaedic Manipulative Therapists (IFOMT) has as its vision statement the "Worldwide promotion of excellence and unity in clinical and academic standards for manual/musculoskeletal physiotherapists". To this end, IFOMT has recently sponsored several conference panel sessions and a survey of Member Organizations (MO) and Registered Interest Groups (RIG) about current practice regarding cervical spine manipulation and pre-manipulative screening in each country. The purpose was to determine common elements of cervical spine manipulative practice and pre-manipulative screening between countries. Importantly, these outcomes were to be used to help reach an initial international agreement at a meeting of MOs regarding the development of an IFOMT International Consensus Document on Safe Manual Therapy in the Cervical Spine. **Subjects:** All twenty MOs and two RIGs responded to the survey in late 2007. All MOs attended a closed session on the development of an international document at the IFOMT Conference in Rotterdam in June 2008. **Method:** A questionnaire consisting of fifteen closed and open ended questions was sent by the IFOMT secretariat to all twenty MOs and ten RIGs. The MOs were subsequently invited to a closed discussion session led by the Standards Committee of IFOMT. **Analyses:** Simple descriptive statistics. **Results:** The main findings of the survey included: 85% of MOs use pre-manipulative guidelines, with Australian guidelines commonly

adopted internationally (50%); provision of information re serious adverse responses is not standard practice in all countries; positional tests for vertebrobasilar insufficiency (VBI) are used by most MOs, especially the pre-manipulative position (100%); craniovertebral ligament testing is often taught as a pre-manipulative screening tool; and use of upper cervical spine manipulation has declined in some countries and most (65%) minimise the rotation component. The agreed outcomes for an international document included: the Australian pre-manipulative guidelines be used as a starting point for developing an IFOMT endorsed document; consideration be given to including at least the pre-manipulative positional test for VBI; consideration be given to including some information on craniovertebral ligament testing; recommendations on informed consent need to be sufficiently flexible for different jurisdictions (i.e., inclusive of all MOs); and some information be included on preferred manipulative practices. **Conclusions:** There are common elements across MOs and there is unanimous international support for the development of an IFOMT International Consensus Document on Safe Manual Therapy in the Cervical Spine. It was agreed between MOs that the document should be reflective of best practice and research, flexible and simple in application, legally suitable to individual countries, an aid to clinical reasoning, and informative but not prescriptive. **Clinical Relevance:** The development of an IFOMT endorsed document will be of assistance to manual therapy clinicians worldwide in safely managing disorders of the cervical spine.

CLINICAL DECISION MAKING ASSOCIATED WITH AN UNDETECTED ODONTOID FRACTURE IN AN OLDER INDIVIDUAL REFERRED TO PHYSICAL THERAPY FOR THE TREATMENT OF NECK PAIN

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Purpose: This report describes the examination of and decision-making process for a patient referred to physical therapy for the treatment of neck pain following trauma who had an underlying odontoid fracture that precluded physical therapy intervention. **Subject:** This case involved a 73-year-old woman who had a sudden onset of neck and left upper extremity pain after a fall 15 days prior to her initial physical therapy visit. **Method and Analyses:** Conventional cervical spine radiographs completed 1 day prior to her initial physical therapy visit were negative for a fracture. However, several components of this patient's history and physical examination were consistent with a condition for which physical therapy intervention would not be indicated until more definitive cervical spine diagnostic imaging had been completed; more specifically, the physical therapist was primarily concerned about the possibility of an undetected fracture. The patient was an older woman previously diagnosed with osteoporosis who reported a history of trauma to her cervical spine region 15 days prior that continued to cause significant pain in the cervical region and left upper extremity. The patient complained of pain that was constant in nature and worst at night, which caused significant difficulty sleeping. The patient also had significantly limited active cervical spine range of motion and significant midline palpatory tenderness throughout the cervical spine. Furthermore, upon review of the radiographs by the physical therapist which were completed 1 day prior, it was noted that the radiographic images were generally underexposed, which may not allow for adequate interpretation. **Results:** The referring physician was contacted and immediate magnetic resonance imaging was requested which revealed a type II fracture of the odontoid. Thirty-four days after her fall, the patient underwent a C1-C2 fusion. **Conclusion and Clinical Relevance:** When evaluating patients with neck pain who have a history of cervical spine trauma, it is important that physical therapists understand the clinical findings associated with cervical spine fractures, as these findings provide guidance for the use of cervical spine diagnostic imaging and medical referral prior to implementing physical therapy interventions. In this patient, a history of a fall, age greater than 65 years, severe neck pain which was worst at night, and significant pain with midline cervical spine palpation lead to the suspicion of an undetected fracture despite a negative initial radiographic report. This suspicion led to the physical therapist contacting the referring physician to suggest the need for additional diagnostic imaging studies that confirmed a fracture of the odontoid.

THE EFFECT OF NECK POSITION ON CERVICAL SPINE STIFFNESS

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Purpose: To determine the effect of neck position on cervical spine stiffness. When selecting appropriate manual treatment interventions, physical therapists commonly assess cervical spine stiffness manually using posterior-to-anterior (PA) applied pressure over the spinous and articular processes. Selecting appropriate treatment interventions requires reliable manual assessment. The position of the neck may be one factor that affects the reliability of manual stiffness assessment, thus influencing treatment choices and subsequently patient outcomes. **Subjects and methods:** Twenty-five asymptomatic subjects lay prone while their cervical spine stiffness was measured over the spinous process of C4 in four different neck positions in randomized order: neutral, flexion, extension, and a self-se-

lected position. A custom-designed device simulated manual stiffness assessment by applying five cycles of oscillatory PA force at 1 Hz while measuring the resistance to spinal movement (N of force) and the simultaneous displacement (mm of movement). Stiffness was defined as the average slope of the force-displacement curves for oscillatory cycles two through five. Prior to stiffness measurements, the spine was preconditioned using five cycles of standardized oscillatory force applied with the device. Age, gender, height and weight of subjects were recorded. **Analyses:** Differences in spinal stiffness between neck positions were determined using repeated measures analysis of variance, with Bonferroni-adjusted pairwise comparisons. Potential associations between cervical spine stiffness and subject characteristics were investigated with linear regression. **Results:** Cervical spine stiffness differed with neck position ($p < 0.001$). Stiffness was greatest in the flexed position (mean 4.3 N/mm, SD 0.9) followed by the neutral (3.9, 1.1) and self-selected positions (3.6, 0.9), with the lowest mean stiffness recorded in extension (3.1, 1.2). Pairwise comparisons of neck positions indicated that neutral was significantly stiffer than extension ($p = 0.001$), while self-selected was less stiff than flexion ($p = 0.001$), stiffer than extension ($p = 0.044$) and no different to neutral ($p = 0.118$). Subject characteristics were not associated with cervical spine stiffness in any neck position. **Conclusions:** The position of the neck affects cervical spine stiffness, as assessed using standardized PA-applied force. Cervical spine stiffness is greater in flexion and less in extension. **Clinical relevance:** Changes in neck position will affect the stiffness palpated by therapists, potentially reducing the reliability of this assessment. Standardizing a patient's neck position should result in increased reliability in manual stiffness assessment, potentially leading to increased effectiveness in the selection of manual treatment techniques.

MANAGEMENT OF A PATIENT WITH SUB-ACUTE RIB CAGE PAIN USING MANUAL PHYSICAL THERAPY TECHNIQUES, FEAR-AVOIDANCE BELIEF EDUCATION, AND EXERCISE

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Purpose: Emerging evidence supports the model of regional-interdependence especially between the spine and extremities. To date there are very few published studies demonstrating regional interdependence between the spine and rib cage. The purpose of this case report is to provide additional evidence for the interdependence between the spine and rib cage by describing the use of manual physical therapy, exercise, and education to the spine and rib cage in managing rib cage pain. **Subject:** The patient was a 63-year-old woman who presented with complaints of intense burning pain localized to her left anterior chest wall, aggravated with inhalation and coughing. There were no reported easing factors. The pain began 18 days prior to the initial physical therapy visit, following a motor vehicle accident at which time the patient's chest was forcefully thrust against the steering wheel of her car. X-rays, taken in the emergency room, did not reveal any fractures or dislocations in her spine or rib cage. During the physical therapy evaluation the patient did not report of any medical red flag symptoms, and ligamentous integrity testing and minimized deKleyn's tests did not rule-in cervical instability or cervical arterial dysfunction respectively. Further examination revealed painful rib cage excursion with inhalation, tenderness over the costochondral junctions of ribs 3 through 7 on the left side, cervical and thoracic segmental hypo-mobility, limited cervical and thoracic spine AROM, and decreased deep cervical flexor muscle endurance. **Methods:** Initial and discharge outcome measures included rib cage pain intensity, utilizing a Numerical Pain Rating Scale (NPRS); fear associated with physical activity and work, determined with the physical activity and work components of the Fear Avoidance Beliefs Questionnaire (FABQ-PA, FABQ-W); perceived functional disability, assessed with the Functional Rating Scale (FRS); and patient perceived change in condition, measured with a Global Rating of Change Scale (GROC). The patient was treated 11 times over the course of four weeks utilizing thrust and non-thrust manipulations to the cervical spine, thoracic spine, and rib cage; stretching of cervical and chest wall musculature; fear-avoidance belief education; and exercises to improve joint mobility and range, deep cervical flexor endurance, and generalized fitness. **Analysis/Results:** From the initial assessment to the discharge assessment, pain intensity decreased from 8-9/10 to 0-2/10; FABQ scores decreased from FABQ-PA 17/24 and FABQ-W 24/42 to 0/24 and 0/42 respectively; and FRS scores decreased from 66% to 10%; The discharge GROC score was +6. **Conclusion/Clinical Relevance:** The patient initially presented with intense post-traumatic sub-acute left sided anterior rib cage pain associated with additional impairments, but by discharge all outcome measures including pain, function, and fear had improved; and the patient reported her condition to be a "great deal better". Thus, this case demonstrates the efficacy of a multimodal physical therapy treatment approach integrating manual physical therapy, exercise, and education to the spine in addition to the ribcage in improving traumatic sub-acute rib cage pain; and further supports a relationship between the spine and rib cage.

ANTERIOR-POSTERIOR PALPATION OF CERVICAL SPINE: ANATOMIC STUDY

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Purpose: Many manual therapists use anterior-posterior palpation of the cervical spine. Other than stating that the pressure should be directed at the anterior tubercles, previous authors did not quantify how to palpate to avoid performing a carotid sinus massage instead. Therefore, the purpose of this study is to investigate the anatomical landmark of the carotid sinus and common carotid artery so as to avoid it when performing anterior-posterior palpation

of the middle to lower cervical anterior tubercle

Subjects: 4 embalmed cadavers (2 males and 2 females; mean age of 78, range 65 to 92). **Methods:** 8 carotid arteries were dissected. Measurements were taken using a Venier caliper. **Analyses:** Descriptive mean distance from midline to medial carotid artery system (common carotid or carotid sinus) were used to quantify the location of the carotid sinus and common carotid artery at the hyoid and thyroid/cricoid cartilage levels respectively. **Results:** All 4 hyoid lie anterior to C3, all thyroid cartilages lie anterior to C4 and C5 and all 4 cricoid cartilages lie anterior to C6 vertebra. The right and left common carotid arteries lie anterior to the anterior (carotid) tubercles. C3/4 disc corresponds to C4 anterior tubercle, C4/5 to C5, and C5/6 to C6. Midline to lateral hyoid border distance averages 2.05 cm (range 1.7 to 2.5). At the hyoid level, midline to right medial carotid sinus distance averages 2.45 cm (range 2 to 3), left 3.12 cm (range 2.4 to 4.4); midline of C3/4 disc level to medial border of uncinate process average distance is 0.93 cm (range 0.82 to 1.1). Midline to lateral thyroid border mean distance is 2.3 cm (range 2 to 2.5). At the level of thyroid cartilage, right midline to medial border of common carotid artery mean distance is 2.45 cm (range 1.6 to 3), left 2.65 cm (range 2.35 to 3.2). From midline of C4/5 disc level to medial border of uncinate process average distance is 0.96 cm (range 0.8 to 1.05); midline of C5/6 disc to medial uncinate mean distance is 1.06 cm (range 0.82 to 1.2). At the level of cricoid cartilage, right midline to medial border of common carotid artery average distance is 2.15 cm (range 1.8 to 3), left 2.64 cm (range 2.3 to 3.15). **Conclusion:** The anterior tubercles of C4 to C6 may not be palpated directly using anterior-to-posterior pressure because of the overlying location of the carotid sinus and the common carotid arteries. The hyoid, thyroid, and cricoids cartilages may have to be moved contralaterally to allow more room for palpation. **Clinical Relevance:** The hyoid, thyroid, and cricoid cartilages may be used as landmarks when performing anterior-posterior pressures.