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Guest Editorial:
A Tribute to Margot Miller, PT

1947-2015

It is with deep sadness we inform you that Orthopaedic Section colleague member Margot Miller, of Cloquet, MN, passed away in St. Luke's Hospital in Duluth, on September 25, 2015 as a result of complications due to gall bladder surgery (http://www.atkins-northlandfuneralhome.com/obituaries/obituary-listings?obId=625830#/obituaryInfo). Everyone who encountered Margot couldn't help but get swept up in her zest for life! She has been described as a jewel, and I think that aptly represents her radiance, sparkling personality, and the treasure that she was to all of us. We will miss her warm smile, kind and encouraging words, and the humble self who would not want us to give her special tribute for all she did and all she was to us.

Margot served the Orthopaedic Section with her characteristic enthusiasm, passion, and commitment. She was the Treasurer and then the Membership Chair of the Occupational Health Special Interest Group (OHSIG) from 2003-2006 and then President from 2006-2013. Under her leadership as President of the OHSIG, she produced guidelines to benefit both clinicians and other stakeholders. She chaired the Task Force for Revision of the Functional Capacity Evaluation Guidelines, and others. The OHSIG published an Executive Summary of the Occupational Health Practice Analysis and Margot was instrumental in working with the American Physical Therapy Association (APTA) to establish an Alliance between APTA and Region V OSHA. She led efforts for recognition of Occupational Health Physical Therapy as a specialized area of practice. Most recently, she participated in the Work Rehab Clinical Practice Guideline development group. Working with the Private Practice Section IMPACT magazine on the editorial board and as assistant managing editor (2003-2014), she sought out experts to contribute articles on the topic of Occupational Health in practice. She continued to serve as an invaluable resource to subsequent leadership of the SIG; she was always just a phone call away.

In addition to her professional contributions to the Orthopaedic Section, APTA, Inc., she was presented with the Private Practice Session (PPS) Volunteer of the Year in November 2014 for her work on the editorial board of the PPS Impact publication from 2003-2014. Margot also served as a member of the PPS Finance Committee, and on the APTA Public Relations Media Corp representing Overuse Syndromes, Repetitive Strain/Stress Injuries, Technology, and Physical Therapy. Her participation on committees or Task Forces was never in name only! You could count on Margot to give her all, bring a team together, and get the task at hand accomplished.

Margot Miller graduated with honors with a Bachelor of Science in Physical Therapy from the University of Minnesota School of Physical Therapy in May 1969. She held various occupational health physical therapy positions in the Midwest including those with Polinsky Medical Rehabilitation Center, Duluth, MN, Advantage Health Systems, Kansas City, KS, and Isernhagen Work Systems, Duluth, MN. For the past 14 years, she was a member of the faculty and executive clinical management at WorkWell, Inc. in Duluth, MN. Most recently she was an integral part of the WorkWell Leadership Team where she oversaw Operations, Onsite Service Delivery and Training, Clinical Practice, Clinical Policies and Procedures, and Functional Testing. She was a mentor to her own clinical staff and to innumerable others in physical therapy for whom she provided training in work injury prevention and rehabilitation or worked side-by-side on advocacy issues for state chapters and components. She was a sought after presenter and speaker, and author of over 30 professional articles in occupational health and business publications.

Our condolences and heartfelt sympathy go out to her husband of 46 years, Rick; children, Amy (Glenn) Miller, Lori (John) Livingston, and Paul (Erin) Miller; siblings, Janene (Gary) Eilola, Marc Rabideau, and Jaclyn (Craig) Carter; grandchildren, Jared Leslie, Maya and Naomi Miller, and Michael and Jason Livingston; several nieces and nephews. Margot will be greatly missed by all of the colleagues and friends she has known and touched over the years.

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The Effect of Spinal Mobilization on Pressure Pain Threshold: A Review of the Literature

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ABSTRACT

Background: Non-thrust mobilizations (NTM) are a common intervention for the treatment of pain; however, their effectiveness in the treatment of spinal pain have varied. **Purpose:** The purpose of this paper was to review the effects of NTM as measured by pressure pain threshold. **Methods:** A search was conducted in relevant databases and 135 article abstracts were screened. After full text examination, 7 articles met the inclusion criteria and 2 were added from a hand search. **Findings:** The majority of the studies in this systematic review whose participants were symptomatic had significantly increased pressure pain threshold (PPT) values after mobilizations were performed compared to control groups. **Clinical Relevance:** Our systematic review suggests that NTM has a favorable effect on increasing PPT, or reducing pain sensitivity when compared to placebo interventions. **Conclusion:** Clinicians should consider NTM as part of their overall rehabilitation in patients with painful spinal pathologies.

Key Words: manual therapy, non-thrust mobilization, spine pain

INTRODUCTION

Spinal manipulative therapy (SMT) is a commonly used intervention employed by physical therapists for the treatment of pain.[1,2] Spinal manipulative therapy consists of both thrust mobilization (TM), commonly referred to as manipulation, and non-thrust mobilization (NTM), with the main difference involving the amplitude and velocity of force applied to the targeted vertebrae.[3] Typically, TM involves a high velocity, low amplitude thrust at the end-range of movement, while NTM involves small or large amplitude oscillations within the joints available range of movement.[4] Several studies have compared the effectiveness of TM versus NTM in the treatment of spinal pain, and the results have varied.[2,5-7]

While SMT has been shown to be an effective intervention in the reduction of pain, the underlying mechanisms are not completely understood. Researchers have assessed the effects of SMT through alterations in nociceptive input to the central nervous system by measuring pain sensitivity.[8] In 2009, Bialosky demonstrated an immediate reduction in pain sensitivity following lumbar SMT in those with low back pain (LBP).[8] Pain sensitivity is a widely used term with several forms of measurement. It may be measured by sensory modalities such as thermal, mechanical, electrical, ischemic, and chemical stimuli applied to different regions of the body.[9]

One commonly applied measurement to assess pain sensitivity is pressure pain threshold (PPT). The PPT can be assessed with an inexpensive device and has shown good intrarater and interrater reliability as well as substantial test-retest reliability.[10] Pressure pain threshold is defined as the least amount of mechanical stimulus intensity applied at which an individual reports pain.[11] It has been demonstrated that individuals with LBP have lower PPT values as compared to their healthy counterparts and PPT may further decrease with chronic pain.[10,12,13] In some cases, PPTs have been shown to be useful when used during a clinical assessment to assist in predicting short-term outcomes in conditions such as whiplash-associated disorder.[10]

To date, the authors are aware of only two systematic reviews that have analyzed the effects of SMT on PPTs. These reviews, which only investigated studies involving TM, found that TM appears to have a favorable effect on increasing PPTs.[14,15] At the time of this writing, there have been no systematic reviews published to assess the quality of literature examining the effects of NTM of the spine on PPTs. The purpose of this systematic review is to determine if evidence exists to suggest NTM applied to the spine are associated with increased PPT and if suggestions can be made regarding the parameters of their use.

METHODS

Search Strategy

A systematic search of relevant literature was conducted between January and March 2014. A comprehensive search, with no language restriction, was conducted in the following databases: PubMed, Google Scholar, CINAHL Plus with Full Text, OvidSP, and PEDro. The following text and key words were searched in various combinations as outlined in Figure 1: pressure, pain sensitivity, pressure pain, pressure pain threshold, mobilization, manipulation, cervical manipulation, thoracic manipulation, lumbar manipulation, cervical mobilization, thoracic mobilization, and lumbar mobilization. We also searched the references of selected articles.

Study Selection

We included randomized-controlled trials (RCTs) that investigated the effects of NTM directed to the spine (grade IV or less) on pain.[4] These studies were included for review if the articles: (1) used NTM in the treatment, (2) included a pre- and post-outcome measurement of PPT, and (3) were published after January 1998. We noted the parameters used in the research, the location of treatment, and subject description.

From the results of the initial search the first reviewer (AW) evaluated the titles and abstracts of retrieved articles for possible inclusion. Retained titles were assessed by 2 independent reviewers (SK and AW) for potential inclusion and retrieval of the full text article. Full text articles were screened independently for inclusion by 2 reviewers (SK and AW). In two cases, the 2 reviewers were unable to reach consensus, and a third reviewer was consulted (JB).

Quality Assessment

The methodological quality of included

articles was assessed independently by 2 reviewers (SK and AW) using the Sources of Risk of Bias tool developed by the Cochrane Back Review Group.[16] This tool is comprised of 12 items that are individually scored as either yes, no, or unsure (Table 1). The risk of bias tool covers 6 domains of bias: selection bias, performance bias, detection bias, attrition bias, reporting bias, and other bias.[17] The reviewers familiarized themselves with the Sources of Risk of Bias tool and the scoring system prior to the evaluation in order to avoid quality assessment bias. The 2 reviewers (SK and AW) independently scored each of the 12 items yes or no. Items were scored as unsure when information lacked enough detail for the reviewers to decide whether or not the study satisfied a specific item.[18]

Scoring and Quality of Papers

The Sources of Risk of Bias tool does not incorporate a system for scoring quality. For this systematic review, we used the Grading of Recommendations Assessment Development and Evaluation (GRADE) method proposed by the Cochrane Handbook of Systematic Reviews of Interventions and the Cochrane Back Review Group CBRG Editorial Board.[16] The GRADE tool offers a system for rating quality of evidence in systematic reviews and guidelines. It is also a system that grades the strength of recommendations in the guidelines.[17,19] The quality of evidence on a specific outcome is based on 5 domains: study design limitations, inconsistency of results, indirectness of evidence, imprecision of results (insufficient or imprecise data), and reporting bias.[16,17] The GRADE Working Group recommends 4 levels for quality evidence: high quality evidence, moderate quality evidence, low quality evidence, and very low quality evidence. In addition, the GRADE system offers two grades of recommendations: strong and weak. When the desirable effects of an intervention clearly outweigh the undesirable effects, or clearly do not, guideline panels offer strong recommendations. When the trade-offs are less certain, either because of low quality evidence or because evidence suggests that desirable and undesirable effects are closely balanced, weak recommendations become mandatory.[17]

RESULTS

Search Results

The initial electronic database search yielded a total of 1195 articles (Figure 1). After removing duplicates and reviewing all titles for key words and context, 135 articles were selected for possible inclusion. After full text examination, 7 articles met the inclusion criteria and 2 were added from the hand search. These articles detailed the use of NTM in all areas of the spine and assessed PPT changes in both symptomatic and asymptomatic individuals. The items that satisfy the Risk of Bias Tool were analyzed and ranged from 5 to 11 out of a possible 12.[16] A moderate quality of evidence was given to our review based on the grade tool (Tables 2 and 3).

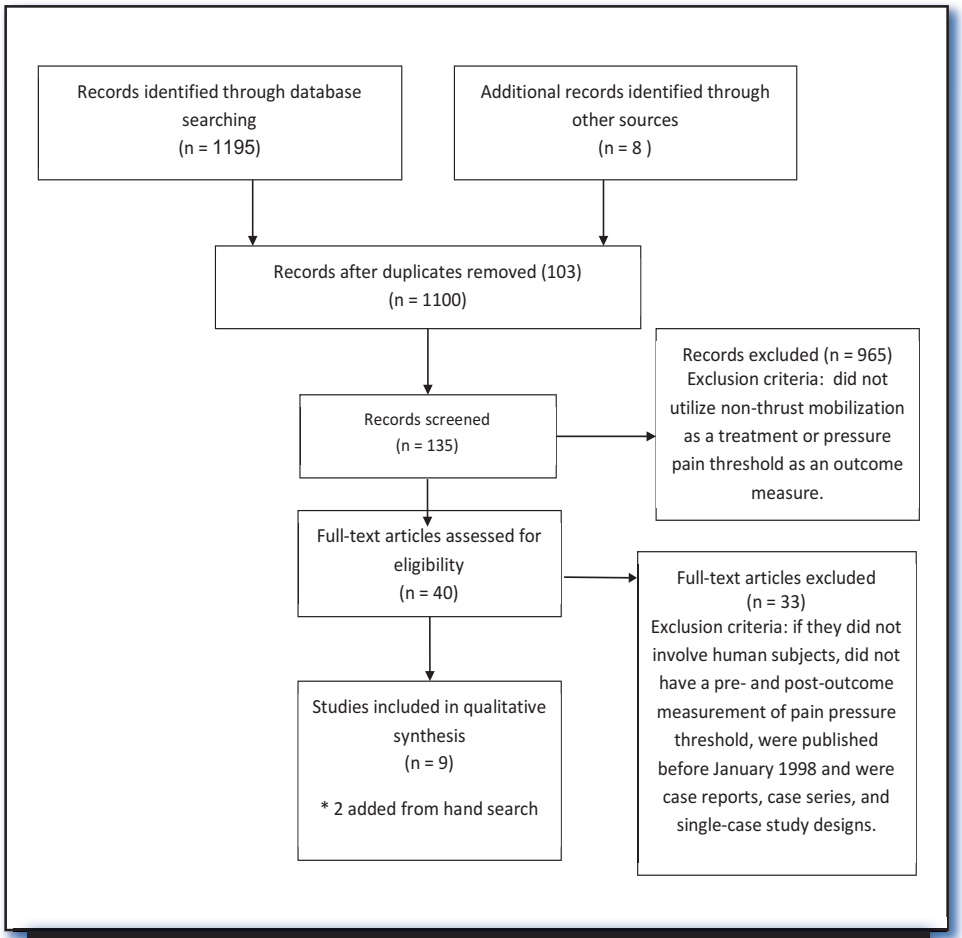

Figure 1. Study selection process.

Characteristics of Studies

Detailed characteristics of the study design, participants, intervention, pain sensitivity measure, summary of results, and values are available in (Table 2). The sample populations of interest were asymptomatic and symptomatic human participants. Four of the 9 studies were double-blind RCTs and the remaining 5 studies were single-blind RCTs. Five of the studies used cervical NTM, 3 of the studies used lumbar NTM, and 1 study used thoracic and lumbar NTM as the intervention.

Pressure Pain Threshold

In 7 of the studies, the PPT values increased after NTM compared to the placebo and control group (just manual contact).[20-26] Out of those 7 studies, 3 used cervical NTM as the intervention. Sterling showed that grade 3 posterior-anterior (PA) cervical NTM to C5-6 increased the PPT on the side of the treatment on a group of patients with whiplash-associated disorder. A post-hoc analysis demonstrated a significant difference between treatment and placebo and treatment and control.[27] Other authors noted positive results in the cervical spine. La Touche[24] found that PPT in the craniofacial and cervical regions significantly increased after PA NTM to the occiput, atlas, and axis. The oscillations were applied for 6 minutes once every two seconds for a total of 3 two-minute intervals with a 30-second rest.[24] Vicenzino showed that there was a significant increase in PPT following a grade 3 oscillatory lateral glide to C5-6 when directed contralaterally to the affected upper limb of the subjects.[26]

Dhondt observed a significant increase

Table 1. Sources of Risk of Bias Score

Author of Study	1	2	3	4	5	6	7	8	9	10	11	12	Total
Snodgrass	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	11
Sterling, Pedler	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	11
La Touche	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	11
Willett	Y	Y	Y	N	U	Y	Y	Y	Y	N	Y	Y	9
Soon	Y	Y	Y	N	Y	N	Y	Y	U	N	U	Y	7
Krouwel	Y	Y	Y	N	U	Y	Y	Y	U	N	Y	Y	8
Dhondt	Y	Y	Y	N	Y	N	Y	Y	U	Y	U	Y	8
Sterling	Y	Y	Y	N	Y	N	U	Y	U	N	U	Y	6
Vicenzino	Y	Y	Y	N	Y	N	Y	Y	U	N	U	Y	7
Pentelka	N	Y	Y	U	U	N	Y	Y	U	N	U	Y	5

Item Criteria

1. Was the method of randomization adequate?
2. Was the treatment allocation concealed?

Preventing knowledge of the allocated interventions during the study:

3. Was the patient blinded to the intervention?
4. Was the care provider blinded to the intervention?
5. Was the outcome accessor blinded to the intervention?

Addressing incomplete outcome data:

6. Was the drop-out rate described and acceptable?
7. Were all randomized participants analyzed in the group to which they were allocated?
8. Are reports of the study free of suggestion of selective outcome reporting?

Other sources of potential bias:

9. Were the groups similar at baseline regarding the most important prognostic indicators?
10. Were co-interventions avoided or similar?
11. Was the compliance acceptable in all groups?
12. Was the timing of the outcome assessment similar in all groups?

Abbreviations: Y, yes; N, no; U, undecided

in PPT values at the T6, L1, and L3 paraspinals in subjects who received spinal NTM at T12-L4.[23] The study used an NTM technique, which varied manual oscillations, frequency, and amplitude. Every 2 minutes the manual oscillation technique changed from right rotation to left rotation and from ventral to dorsal translation. The NTM frequency changed from 1.5 minute high to 0.5-minute low frequency and the amplitude alternated between small amplitude at the beginning of range of motion (ROM) to large amplitude in the middle ROM.

Amplitude

Pentelka observed that after 4 sets of large amplitude posterior to anterior NTM (lasting 30 – 60 seconds) to L4, oscillating at a rate of 1 Hz, there was a statistically significant increase in PPT.[21] Conversely, Willett found that large amplitude grade 3 NTM applied to L5 increased PPT in subjects regardless of if they were applied at a 2 Hz, 1 Hz, or a static rate.[22] Krouwel demonstrated a significant increase in PPT following lumbar NTM with varying amplitudes. The subjects were treated with either a large amplitude (between 50-200 N) or small amplitude (150-200 N).[28]

In two studies, there was no change in PPT values after NTM. Soon discovered no significant difference in PPT after a grade 3 PA C5-6 NTM was performed to asymptomatic individuals.[20] Sterling and Pedler found similar increases in PPTs at the cervical spine following both NTM and manual contact.[29] Snodgrass found that for the high-amplitude NTM, low-amplitude NTM, and the placebo group consisting of a detuned laser treatment, PPT values all significantly increased from their baseline values. However, there were no significant changes in PPT values between groups.[30]

Duration, Rate, Amplitude

Pentelka performed 5 sets of large amplitude oscillatory NTM to asymptomatic individuals applied to L4 at a rate of 1 Hz. They varied the duration of NTM between 30 or 60 seconds and discovered no statistically significant difference between 30 vs. 60 s of NTM. There was a tendency for PPT values to be higher for the 60 s interventions. All PPT measurements taken after each NTM set were significantly higher than baseline, which suggests that lumbar NTM may reduce pain sensitivity in asymptomatic individuals. Based on this study, it appears that the choice of 30 or 60 seconds of duration does not impact PPT.[21]

Willett performed grade 3 PA NTM at L5 to asymptomatic individuals altering the rates of NTM between 1 Hz, 2 Hz, or quasi-static pressure. Pain pressure threshold increased after NTM regardless of the rate. It appears that the rate of NTM does not affect the amount of pain sensitivity reduction after NTM.[22]

Krouwel applied PA NTM to L3 in asymptomatic individuals and varied the amplitude. They used a large amplitude (between 50-200 N), a small amplitude (between 150-200 N) or a "quasi-static" amplitude (200 N of sustained pressure). The results indicated no difference between amplitude conditions; however, PPT significantly increased after each of the NTM conditions.[28] Each of these studies suggests that lumbar NTM in asymptomatic individuals significantly increase PPT, thus reducing pain sensitivity, regardless of the duration, rate, or amplitude.[22,26,28]

Visual Analog Scale

There were 3 studies that found a decrease in the visual analog scale (VAS) to after NTM. Sterling and La Touche both found that VAS score significantly decreased after cervical NTM.[24,27] In the La Touche study, decrease in VAS scores were maintained from one session to the next and showed an average decrease of 41.7% after 3 applications.[24] Snodgrass found that there was a significant time-by-group difference for pain. The high-amplitude NTM group had more pain immediately after treatment than the low-amplitude NTM group and placebo group. However at follow-up, the high-amplitude NTM group had pain that was significantly less than the low-amplitude STM group.[30]

Symptomatic versus asymptomatic subjects

Our review included studies where the individuals were asymptomatic and symptomatic, which is similar to the systematic review on TM by Coronado.[14] The study by Soon used asymptomatic individuals and grade 3 NTM at C5-6. They found that there was no change in PPT between the NTM group and manual contact/control group.[20] Pentelka, Willett, and Krouwel all performed studies assessing the effects of lumbar NTM on asymptomatic individuals and discovered the PPT values to significantly increase post-NTM compared to the control group.[21,22,28]

Sterling and Pedler performed NTM to C5-6 on symptomatic individuals with chronic whiplash-associated disorder and found no significant change in PPT when comparing the NTM group to a manual contact group.[29] Sterling and Jull performed grade 3 NTM to C5-6 on individuals with cervical pain. They found that there was a significant increase in PPT and a decrease in VAS score between the NTM group and the manual contact group.[27] Vicenzino treated subjects with lateral epicondylalgia using grade 3 NTM to C5-6 and discovered significantly increased PPTs after cervical NTM.[26] La Touche found that cervical NTM significantly decreased VAS scores and increased PPT compared to manual contact in symptomatic patients suffering from cervico-craniofacial pain.[24] Dhondt assessed individuals with rheumatoid arthritis and concluded that NTM to T6, L1, and L3 significantly increased PPT values.[23] Snodgrass randomly divided participants with neck pain into 3 groups—cervical TM, cervical NTM, and a placebo laser group—and found significantly increased PPT values in all.[30]

Spinal Region

All of the studies in our systematic review where NTM were applied to the lumbar spine showed significantly increased PPT values in the NTM group compared to the control.[7,8,22,31] Two of the studies that conducted cervical NTM found no change in PPT values when comparing the NTM group to the manual contact group,[5,6] while one found no change in PPT compared to a placebo group.[30] The remaining 3 studies that used cervical NTM as the treatment found a significant increase in PPT values when comparing the NTM to the control.[4,11,14]

DISCUSSION

Limitations

There are several limitations in this review. While most of the studies demonstrated low risk of bias, there is the potential for error in some of the scoring items. Three of the 9 performed the entire study in one session and the remaining 6 studies were completed in just 3 sessions.[4-8,11,14,22,31] All of the studies assessed immediate effect where objective values were taken immediately following the NTM or manual contact control. With an immediate effect study, there is little concern for drop-outs (Item 6), compliance (Item 11), and timing of an assessment (Item 12).[17]

Only two of the studies used concomitant clinical pain reports following NTM. Including more studies with VAS scores or other clinical pain reports may help to further strengthen the relevance of an increased PPT. The research reviewed included both symptomatic and asymptomatic subjects. We chose to include both to give a broader picture of the effects of NTM. Both acute and chronic patients were assessed, which may have implications regarding the individual definition of pain and its effect on the patient's function. In addition, some of the studies included other physical therapy interventions when assessing the effects of NTM. Therefore, we do not know to what extent NTM produced the varying effects on PPT when combined with other interventions.

CONCLUSIONS

This is the first systematic review to evaluate the current evidence for NTM and its effects on pain as measured by PPT. The majority of the studies in this systematic review whose participants were symptomatic had significantly increased PPT values after NTM was performed. Therefore, we suggest clinicians include NTM in their patient care and use their clinical decision-making, including immediate patient feedback, to determine the appropriate parameters for each individual. Objectively, clinicians may use PPT to determine how their patients best respond to NTM when the goal is to decrease pain. However, we caution that the mechanism of increased PPT remains unclear and may be the result of neuronal excitability or higher brain centers.[10]

This study contributes to the growing amount of evidence suggesting SMT can produce immediate improvements in pain sensitivity.[1,9,10,12,13,32-34] Considering these effects, NTM may be used to improve PPTs, and allow for greater exercise tolerance following treatment. Although our review found positive effects from NTM, there is not significant agreement among parameters that would warrant specific recommendations. Immediate feedback and appropriate communication will guide the clinician's treatment decisions.

Future research needs to be performed to assess the relationship between PPTs and clinical outcomes. While PPT may improve after NTM, functional improvement may not always follow. Randomized control trials using appropriate parameters may help determine the clinical utility of NTM, their effect on PPTs, and their potential ability to improve overall function.

(Continued on page 14)

Table 2. Study Characteristics

Author and Year	Design	Participants	Intervention
Snodgrass 2014	Randomized controlled trial	64 individuals with nonspecific neck pain of at least 3 months in duration Number of females: 48 Mean age Low Force Group: (SD) 32.1 (11.4) Mean age High Force Group: (SD) 34.4 (12.5) Mean age Placebo Group: (SD) 33.7 (11.8)	Group A (SMT – Low Force): Grade III PA mobilization to the most painful spinous process. Received 3 sets of 1-minute intervals. Applied with 30-N mean peak force. Group B (SMT – High Force): Grade III PA mobilization to the most painful spinous process. Received 3 sets of 1-minute intervals. Applied with 90-N mean peak force. Group C (Placebo): Received detuned-laser treatment for 3 sets of 1 minute. Co-interventions: none Duration of therapy: 1 session
Sterling 2001	Condition randomized, placebo-controlled, double-blind, repeated measures design	30 individuals with mid-lower cervical spine pain of insidious onset Number of females: 16 Mean age (SD) 35.8 (14.9)	Group A (SMT): Grade III PA mobilization to articular pillar of C5/6 symptomatic side. Received 3 sets of 1 minute intervals with 1 minute rest between sets. Group B (placebo): Manual contact to articular pillar of C5/6 on symptomatic side but with no movement of vertebral segment. Group C (control): No physical contact between subject and researcher. Co-interventions: none Duration of therapy: 3 sessions
Soon 2010	Double-blind, controlled, within subjects, crossover study	24 individuals with no history of neck or back pain over the last 6 months Number of females: 11 Mean age (SD) 34 (12)	Group A (SMT): Grade III unilateral PA mobilization to left C5/6 segment. Received 3 sets of 1-minute intervals with 1-minute rest between sets. Group B (placebo): light manual contact on the left C5/6 segment Group C (control): No physical contact between researcher and subject Co-interventions: none Duration of therapy: 3 sessions

Pain Outcome Measurements	Summary of Results	Values (pre and post values and location)
PPT: Delivered at rate of 40 kPa/s. Stimulus applied adjacent to the spinous process at the treated spinal level on the right side, the right upper trapezius muscle, midway between C7 and the acromion and the right median nerve trunk at the elbow. Each landmark was tested 3 times, with a 10-second rest between tests, and PPT scores were averaged. VAS: Participants indicated their resting pain at baseline and follow-up by marking a 100-mm VAS, anchored by "no pain" at 0 mm on the left and "worst pain imaginable" at 100 mm on the right. Participants also rated their level of comfort/discomfort with the treatment they received by marking a VAS anchored by "very comfortable" at 0 mm on the left and "very uncomfortable" at 100 mm on the right.	A high mobilization force (90-N mean peak force) significantly decreases spinal stiffness at a short-term follow-up of approximately 4 days after treatment, though stiffness was not reduced immediately after treatment. Also at this follow-up, pain was significantly less following a high-force (90 N) compared with a low-force (30 N) mobilization, but was not significantly different from that of a placebo treatment.	PPT Low Force Group: Baseline: 558.0 ± 263.5 Post-Rx: 590.4 ± 267.1 Follow-up: 634.0 ± 265.7 PPT High Force Group: Baseline: 576.6 ± 273.6 Post-Rx: 637.0 ± 341.3 Follow-up: 671.3 ± 355.0 Placebo: Baseline: 529.9 ± 225.5 Post-Rx: 554.2 ± 290.8 Follow-up: 629.7 ± 357.8 Pain VAS, mm Low Force Group: Baseline: 33.0 ± 17.2 Post-Rx: 27.1 ± 17.9 Follow-up: 26.5 ± 18.6 Pain VAS, mm High Force Group: Baseline: 26.6 ± 21.0 Post-Rx: 38.9 ± 22.2 Follow-up: 15.2 ± 14.8 Pain VAS, mm Placebo: Baseline: 35.9 ± 24.4 Post-Rx: 20.9 ± 21.2 Follow-up: 22.5 ± 20.3
PPT: Stimulus applied over the symptomatic segment and recorded from the posterior aspect of the articular pillars of C5/6 bilaterally. VAS Scores: measured pain at rest in sitting and at end of range of cervical rotation to symptomatic side.	Cervical mobilization technique produced a hypoalgesic effect increased PPT on side of treatment (p=0.0001) and decreased resting VAS scores (p=0.049)	Mean increase in PPT with treatment condition of 22.55 ± 2.4% of baseline on side of treatment
PPT: Delivered at rate of 40 kPa/s. Stimulus applied to posterior aspect of the left and right articular pillar of C5/C6.	The results indicate no significant change in the PPT (p=.85) after PA cervical mobilization.	Treatment condition: Pre-PPT: 279.1; Post-PPT: 295.1 Manual contact condition: Pre-PPT: 286.4; Post-PPT: 291.0 Noncontact condition: Pre-PPT 299.5; Post-PPT: 311.8

(Continued on page 16)

Table 2. Study Characteristics (continued)

Author and Year	Design	Participants	Intervention
Sterling, 2010	Randomized, controlled single-blind, clinical trial	39 individuals with chronic whiplash-associated disorders Number of females: 27 Mean age (SD) 40.5 (13.5)	Group A (SMT): Cervical lateral glide mobilization away from nominated side of pain to C5/6 segment. Received 3 sets of 1-minute intervals with 1-minute rest between sets. Group B (placebo): hand placement and positioning to C5/6 with no neck movement. Co-interventions: none Duration of therapy: 1 session
Pentelka 2012	Single-blinded, randomized, same subject repeated measures crossover design	19 asymptomatic individuals Number of females: 9 Mean age (SD): 31.9 (7.6)	SMT: 5 sets of large amplitude oscillatory mobilizations were applied to L4 at a rate of 1Hz. Experimental condition: The duration of mobilization varied and lasted 30 or 60 seconds. Co-interventions: none Duration of therapy: 1 session
Willett 2010	Single blind, randomized, within subjects; repeated measures design that included 3 experimental procedures in randomized order	30 asymptomatic individuals Number of females: 22 Mean age females (SD): 29.6 (10.3) Mean age males (SD): 36.5 (14.2)	SMT: A large amplitude, Grade III central PA mobilization with a pisiform grip was applied to L5 spinous process. Received 3 sets of 1 minute intervals with 1-minute rest between sets. Experimental condition: Rates of mobilizations varied at each experimental session and were performed at either 1 Hz, 2 Hz, or as quasi-static pressure. Co-interventions: none Duration of therapy: 3 sessions
Krouwel 2010	Single-blind; randomized; within subject; repeated measures design	30 asymptomatic subjects Number of females: 21 Mean age (SD): 26.4 (4.92)	SMT: PA mobilization at L3 was applied for 3 x 1 minute durations with 1-minute rest in between. Experimental condition: large amplitude (between 50-200N), a small amplitude (between 150-200N) or quasi-static (200 N of sustained pressure) mobilization was applied. Co-interventions: none Duration of therapy: 3 sessions

Pain Outcome Measurements	Summary of Results	Values (pre and post values and location)
PPT: A rate of 40 kPa/s was delivered. The stimulus was applied to C6 spinous process, median nerve trunk at elbow bilaterally, and bilateral tibialis anterior.	PPTs at the cervical spine increased following both SMT and manual contact with no difference between interventions.	PPT (C6): Pre-SMT 226.4; Post-SMT 275.6; Pre-Manual contact 216.1; Post-Manual contact 253.4 PPT (Med N): Pre-SMT 279.2; Post-SMT 291.1; Pre-Manual contact 235.8; Post-Manual contact 230.7 PPT (Tib Ant): Pre-SMT 434.4; Post-SMT 463.4; Pre-Manual contact 408.5; Post-Manual contact 416.5
PPT: Delivered at a rate of 1kg/s. The stimulus applied to L4 level (3 cm to R of L4 SP); the S1 dermatome (standardized point in the R lateral foot); L4 dermatome (standardized at the mid medial R leg) and at the mid L deltoid.	4 way ANOVA analysis showed that there was no statistically significant difference between 30 vs 60 s of mobilizations. All PPT measurements taken after each mobilization set were significantly higher than the baseline measurement.	The mean PPTs for 60 sec mobilizations: 6.241 (0.405) kg/cm^2 The mean PPTs for 30 sec mobilizations: 6.206 (0.429) kg/cm^2
PPT: Delivered at a rate of 1 kg/s. Stimulus applied to paraspinal muscles adjacent to L5; L2 and L5 dermatome and first dorsal interossei in the hand.	Results demonstrated immediate and significant improvement in PPT measures irrespective of rate or site tested. Significantly greater change in PPT measure demonstrated local to the site of mobilizations in lumbar paraspinal muscles compared to distally at the hand. No significant difference in PPT between rates of mobilizations.	Mean PPT increase (kg): L5 paraspinal: quasi-static rate 1.18; 1 Hz rate 1.08; 2 Hz rate 1.18 Mean PPT increase (kg) at L5 dermatome: quasi-static rate 0.85; 1 Hz rate 0.64; 2 Hz rate 0.5 Mean PPT increase (kg) at L2 dermatome: quasi-static rate 0.85; 1 Hz rate 0.64; 2 Hz rate 0.77 Mean PPT increase (kg) at 1st dorsal interossei: quasi-static rate 0.51; 1 Hz rate 0.54; 2 Hz rate 0.41
PPT: Delivered at a rate of 1 kg/s. Stimulus applied to center of right erector spinae muscle mass at L3 level; 3 participant finger breadths above proximal surface of their left patella (L3 dermatome); proximal lateral surface of left 5th metatarsal (S1 dermatome) and at mid deltoid distal to greater tubercle	Results demonstrated a significant increase in PPT following lumbar mobilizations at all measured sites. No significant difference between amplitude conditions	Mean PPT increase (kg): L3 paraspinal: large amplitude 1.01; small amplitude 0.78; quasi-static 0.87 L3 dermatome: large amplitude 0.82; small amplitude 0.61; quasi-static 0.52 S1 dermatome: large amplitude 0.53; small amplitude 0.61; quasi-static 0.38 Mid deltoid: large amplitude 0.73; small amplitude 0.68; quasi-static 0.50

(Continued on page 18)

Table 2. Study Characteristics (continued)

Author and Year	Design	Participants	Intervention
Vicenzino 1998	Randomized, double-blind, placebo-controlled, repeated-measures study	24 individuals with chronic lateral epicondylalgia (average duration 6.2 months) Number of females: 13 Mean age (SD): 49	Group A (SMT): Grade III oscillatory lateral glide mobilization of C5/6 motion segment directed contralaterally to affected upper limb. Received three sets of 30 second intervals with 1-minute rest between sets. Group B (placebo): Replicated lateral glide mobilization technique without application of any oscillatory movement. Group C (control): No physical contact between researcher and subject. Co-interventions: none Duration of therapy: 3 sessions
Dhondt 1999	Repeated measure, double-blind, randomized controlled trial	30 individuals with active RA Number of females: 24 Mean age (SD): 55.5 (10.9)	Group A (SMT): Manual oscillation applied at the spinal processes of T12 and L4, each for 6 minutes. The direction of manual oscillations changed every 2 minutes: from right rotation to left rotation, to ventral-dorsal translation respectively. Frequency changed from 1.5 minute high to 0.5 minute low frequency, and their amplitude alternated between a small amplitude at the beginning of ROM of the joint and large amplitude in middle ROM. Group B (control): Individuals rested in the same position as the SMT group. Co-interventions: none Duration of therapy: 1 session
La Touche 2013	Randomized, double-blind, placebo-controlled study	32 individuals with cervico-craniofacial pain of myofascial origin Number of females: 21 Mean age (SD): 33.19 (9.49)	Group A (SMT): Applied posterior directed force on frontal regional of patient with anterior part of shoulder. Oscillations applied at slow rate of 0.5 Hz. Mobilization applied for 3 intervals of 2 minutes with a 30-second rest in between for total treatment time of 7 minutes. Group B (control): PT applied same grips used with the treatment technique. Mobilization was not applied. Patient held for 3 intervals of 2 minutes with 30 seconds of rest in between. Co-interventions: none Duration of therapy: 3 sessions

Abbreviations: SMT, spinal manipulative therapy; PPT, pressure pain threshold; PA, posterior to anterior; VAS, Visual Analog Scale; RA, rheumatoid arthritis;

	Pain Outcome Measurements	Summary of Results	Values (pre and post values and location)
	PPT: Applied at a rate of 40 kPa/sec. It was measured over the lateral elbow using an electronic digital algometer.	Treatment produced hypoalgesic and sympathoexcitatory changes significantly greater than those of placebo and control ($p<0.03$).	Mean PPT improvement (kPa): CLG treatment 75.74 ± 12.69
	PPT: Applied at a rate of 1 kg/cm^2. Stimulus applied to spinal processes of C6, T1, T3, T6, T10, L1, L3, and L5 and 3 cm to the Left of each of the previous locations and 3 cm to the Right. In addition, PPT was also done at the medial side of both knee joints and lateral side of both ankles.	Repeated measurement of the pain threshold in RA patients showed a decrease in all subjects, which was slightly less pronounced after a single manual oscillation than after rest. Significantly higher PPT values were found in the experimental SMT group than in the control group at the paraspinal level of T6, L1, and L3.	Mean values of PPT (kg/cm^2) in SMT Group C6: Pretreatment 2.62; posttreatment 2.52 T1: Pretreatment 3.53; posttreatment 3.29 T3: Pretreatment 3.25; posttreatment 3.17 T6: Pretreatment 3.51; posttreatment 3.52 T10: Pretreatment 3.70; posttreatment 3.52 L1: Pretreatment 3.67; posttreatment 3.81 L3: Pretreatment 3.71; posttreatment 3.57 L5: Pretreatment 3.66; posttreatment 3.54 Knee: Pretreatment 2.98; posttreatment 2.90 Ankle: Pretreatment 2.59; posttreatment 2.62
	PPT: Applied at a rate of 1 kg/cm^2. Stimulus applied bilaterally at 2 points in the masseter muscle, 2 points in the temporalis muscle; suboccipital muscles; C5 zygapophyseal joint and upper trapezius muscle. VAS was used to measure pain intensity of the cervico-craniofacial region at rest and before and after each treatment. Pain intensity was quantified by the assessor in millimeters. The patient placed a mark on the line at the point that they felt represented the intensity of his or her pain at the time.	PPT in craniofacial and cervical regions significantly increased and pain intensity significantly decreased in treatment group compared to placebo. An increase in PPT was observed after the second intervention compared with the pre-session data and after the third intervention compared with the first posttreatment assessment. This is indicative of a maintained increase over the successive sessions. The results of clinical pain intensity measured by the VAS indicate a decrease in the patients' experience of pain at rest with significant differences between treatment and placebo groups. Patients who received the treatment reported a decrease of 29.13 mm in VAS between the pretreatment and third posttreatment assessment.	Mean PPT (kg/cm^2): Suboccipital: pre 2.13; post-one 3.03; post-two 3.46 C5: pre 2.47; post-one 3.09; post-two 3.63 Trapezius: pre 2.61; post-one 3.51; post-two 4.13

CLG, cervical lateral glide

Table 3. GRADE Score

Result: Pain Sensitivity	Moderate quality of evidence: further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate
Item Criteria	
Based on the data provided, can you determine if the results will be clinically relevant? 1. Are the patients described in detail so that you can decide whether they are comparable to those that you see in your practice? 2. Are the interventions and treatment settings described well enough so that you can provide the same for your patients? 3. Were all clinically relevant outcomes measured and reported? 4. Is the size of the effect clinically important? 5. Are the likely treatment benefits worth the potential harms?	

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2016 Annual Orthopaedic Section Meeting

Atlanta, Georgia
Grand Hyatt Atlanta-Buckhead
May 5–7, 2016

Treating the Cervical & Lumbar Spine:

Can Art, Science, and Practice Guidelines All Get Along?

It's that time of year again! Time to register for the 4th Annual Orthopaedic Section Meeting, 2016. The meeting will be held in Buckhead-Atlanta, Georgia, May 5-7, 2016. The theme for the meeting is, "Treating the Cervical and Lumbar Spine: Can Art, Science, and Practice Guidelines All Get Along?"

Our focus during the general sessions is to look at the Myths vs. Realities of the Clinical Practice Guidelines (CPGs) During Differential Diagnosis and Clinical Decision Making for the Cervical and Lumbar Spine. We will then transition into the lab-intensive breakout sessions, which will begin with a case study round table discussion and quickly progress into hands-on instruction, demonstration, and practice with the experts in our field.

We have listened to your feedback and have incorporated some positive changes for 2016. Speakers will present in the morning general session and lead the breakout sessions to facilitate greater educational continuity. This will afford participants more time for the hands-on lab sessions and enhance the overall experience. **We are excited to also invite Physical Therapist Assistants to be a part of the Annual Orthopaedic Meeting and to offer an early bird group discount rate.**

Program Information

Thursday, May 5, 2016

Complimentary (Bonus) Session
3:30PM–5:30PM

Lacking Resources to Implement the Didactic Portion of an Orthopaedic Residency Program? The Section's "Curriculum Package" Can be the Answer you are Looking For!
Speakers: Kathryn R. Cieslak, PT, MS, DSc, OCS; Aimee Klein, PT, DPT, DSc, OCS

Keynote Presentation & Opening Reception: 6:00 PM–9:00 PM

Practice Guidelines and Care Pathways: Moving the Practice of Physical Therapy Forward
Speaker: Julie Fritz, PT, PhD, FAPTA

Friday, May 6, 2016

Friday Schedule: 8:00AM–4:30PM
General Session: 8:00AM–10:30AM

The Neck Pain Clinical Practice Guideline: Strengths, Limitations, and Recommendations for the Future
Speakers: Joshua Cleland, PT, PhD, OCS; Robert Landel, PT, DPT, OCS, FAPTA; Paul Mintken, DPT, OCS, FAAOMPT; Kenneth Olson, PT, DHSc, OCS, FAAOMPT

Concurrent Breakout Sessions:
Following the general session on Friday, four concurrent breakout sessions will be offered. The registrant will attend three out of four breakout sessions following the morning general session, based on order of preference indicated on the registration form. Note: space is limited, and therefore the attendee's breakout session assignments will be given on a first-come, first-serve basis.

Breakout Session 1:
Examination and Treatment of Neck Pain with Radiating/Referred Symptoms
Speaker: Joshua Cleland, PT, PhD, OCS

Breakout Session 2:
Examination and Treatment of Neck Pain with Headache
Speaker: Robert Landel, PT, DPT, OCS, FAPTA

Breakout Session 3:
Examination and Treatment of Individuals with Neck Pain with Movement Coordination Impairments
Speaker: Paul Mintken, DPT, OCS, FAAOMPT

Orthopaedic Section, APTA
2016 CSM Preconference Courses

TUESDAY FEBRUARY 16, 2016

Evidence-based Assessment & Management of Sport-Related Concussion
Kathryn Schneider, PT, PhD, FCAMPT, Clin Spec MSK
Isabelle Gagnon, PT, PhD

Get a Kick Out of Gait Analysis: Implications for the Foot and Ankle
Kathleen Geist, PT, DPT, OCS, COMT, FAAOMPT
Marie Johanson, PT, PhD, OCS
Benjamin M. Rogozinski, PT, DPT

WEDNESDAY FEBRUARY 17, 2016

Dynamic Neuromuscular Stabilization: Assessment and Management of Performing Artists
Clare Frank, DPT, MS, OCS, FAAOMPT
Annette Karim, DPT, OCS, FAAOMPT

For more information,
visit http://www.apta.org/CSM/Programming/

Learn More

The 2016 Annual Orthopaedic Section Meeting will be held at the beautiful Grand Hyatt Atlanta-Buckhead in Atlanta, Georgia. The Grand Hyatt is located on Peachtree Street in the heart of Atlanta's upscale Buckhead neighborhood. Visit the following link for full meeting details, to register, and to reserve your guestroom:
https://www.orthopt.org/content/c/2016_annual_orthopaedic_section_meeting

Breakout Session 4:
Examination and Treatment of Neck Pain with Mobility Deficits
Speaker: Kenneth Olson, PT, DHSc, FAAOMPT, OCS

Saturday, May 7, 2016

Saturday Schedule: 7:45AM–4:45PM
General Session: 7:45AM–10:15AM

Myths and Realities of the Lumbar Spine Clinical Practice Guidelines: Content Update and Techniques for Focusing Examination and Treatment to Match the Demands of Clinical Practice
Speakers: Chad Cook, PT, PhD, MBA, FAAOMPT; Anthony Delitto, PT, PhD, FAPTA; Jake Magel, PT, PhD, DSc, OCS, FAAOMPT; Sheri Silfies, PT, PhD; Michael Timko, PT, MS, FAAOMPT

Concurrent Breakout Sessions:
Following the general session on Saturday, four concurrent breakout sessions will be offered. The registrant will attend three out of four breakout sessions following the morning general session, based on order of preference indicated on the registration form. Note: space is limited, and therefore the attendee's breakout session assignments will be given on a first-come, first-serve basis.

Breakout Session 5:
Physical and Cognitive Behavioral Exercise to Influence Chronic Centrally Mediated Pain
Speaker: Chad Cook, PT, PhD, MBA, FAAOMPT

Breakout Session 6:
Mobility Impairments of the Lumbar Spine
Speaker: Jake Magel, PT, PhD, DSc, OCS, FAAOMPT

Breakout Session 7:
Motor Control/Movement Coordination Impairment of the Lumbar Spine & Pelvis
Speaker: Sheri Silfies, PT, PhD

Breakout Session 8:
Applied Examination Principles and Differential Diagnostic Considerations for the Lower Quarter
Speaker: Michael Timko, PT, MS, FAAOMPT

Saturday Mid-Day: "Lunch-and-Learn"

12:30PM–1:15PM

Clinical Practice - Future Directions
Speaker: Joseph Godges, DPT, MA, OCS

Multimodal Physical Therapy Treatment of a Pediatric Patient Presenting With Complex Regional Pain Syndrome Type I: A Case Report

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ABSTRACT

Background and Purpose: Complex regional pain syndrome (CRPS) is a rare but debilitating pain condition. Existing literature supports a number of physical therapy interventions for adults with CRPS; however, the clinical effectiveness of these interventions has not been established for pediatric patients with CRPS. The purpose of this case report is to describe a multimodal treatment approach for a pediatric patient with CRPS of the right ankle. **Case Description:** The patient was an 11-year-old girl with right ankle pain. Examination findings were consistent with the Budapest diagnostic criteria for CRPS. Initial outcome measures included a Lower Extremity Functional Scale (LEFS) score of 8/80, Tampa Scale of Kinesiophobia (TSK) score of 48/68, and a Pain Catastrophizing Scale for Children (PCS-C) score of 46/52. Treatment involved a modified graded motor imagery program, pain neuroscience education, and a progressive program of functional loading activities guided by a graded pain exposure philosophy. **Outcome:** Following 9 treatment sessions over 5 weeks, PCS-C decreased to 0/52, TSK decreased to 19/68, LEFS improved to 78/80, and the patient no longer met Budapest criteria for CRPS. At 3 months, LEFS scores were sustained (72/80) with no return of widespread foot pain. **Discussion:** Description of clinical findings, interventions, and outcomes of this case may lead to future research for pediatric patients with CRPS.

Key Words: pain exposure, graded motor imagery, adolescent

BACKGROUND AND PURPOSE

Complex regional pain syndrome (CRPS) is a pain syndrome characterized by pain disproportionate to the inciting event with a combination of sensory, autonomic, trophic, and motor abnormalities.[1] Recent evidence has indicated an aberrant inflammatory response, vasomotor or autonomic dysfunction, maladaptive neuronal plasticity, peripheral small fiber neuropathy, and genetic predisposition as all potential pathophysiologic mechanisms behind CRPS.[1] In the pediatric population (<16 years), CRPS occurs more often in Caucasian female children with a mean age of 11.8 years.[2,3] Eighty percent of pediatric patients with CRPS appear to be initiated by minor trauma and the majority affect the lower extremity with 75% of cases involving the foot.[1] Pediatric patients are more likely to present initially with signs consisting of a blue cold affected extremity, minimal to mild swelling, and signs of atrophy are more likely to be seen within muscle tissue.[4] Diagnosis for CRPS is most often based on clinical signs and symptoms using the validated Budapest criteria.[5] The Budapest criteria contains 4 categories of signs/symptoms (1) motor/trophic, (2) vasomotor, (3) sensory, and (4) sudomotor/edema. Motor dysfunction can present as weakness, tremor, dystonia, decreased range of motion, or trophic changes to skin, hair, or nails. Vasomotor dysfunction may present as skin color changes such as rubor, cyanosis, mottling, or as temperature asymmetry. Sensory dysfunction presents most often as allodynia to touch, hyperalgesia to pinprick, and temperature intolerance. Sudomotor/edema dysfunction typically presents as sweating changes or distal limb edema.[5] For a patient to have CRPS, they must have one symptom in 3 different categories and one sign in two different categories, have continuing pain that is out of proportion to the inciting event and no other potential diagnosis to better explain the signs and symptoms.[5] Pediatric patients with CRPS have had remission rates reported of greater than 90% with intensive exercise therapy alone.[6] However, the recurrence rate for the pediatric population is estimated to be between 30% and 50%,[2-4,6] with about 80% of cases reoccurring within the first 6 months following discharge from a treatment program.[4]

Currently, there is no accepted standard of care for nonsurgical treatment of pediatric CRPS.[7] Recently, a number of interventions have shown promise in the CRPS populations including graded motor imagery (left/right discrimination, explicit motor imagery, mirror therapy),[8] functional therapeutic exercise,[6,7] desensitization,[7] graded exposure in vivo,[9] cognitive behavior therapy (CBT),[10] and pain exposure physical therapy.[11] However, many of these treatment approaches have not been studied extensively in children. The purpose of this case report is to describe a multimodal treatment approach in which existing evidence from the adult CRPS literature was adapted and applied for a pediatric CRPS patient.

CASE DESCRIPTION

Patient History and Systems Review

The patient was an 11-year-old white female (54 in, 76 lbs, BMI 18.3) that presented to the clinic approximately 5 weeks from date of initial trauma. She reported entering into her mother's car and hitting the medial aspect of her right ankle just inferior to the medial malleolus against the car frame. She awoke several days later with swelling that did not dissipate and sought care from the emergency room with subjective complaints of tingling, locking, and swelling in her right ankle. X-ray imaging for the right ankle was performed that were unremarkable for fracture, abnormal tissue swelling, or abnormal joint spacing. She then consulted an orthopaedic MD, who prescribed a short leg cast for a period of 15 days for forced rest. Following cast removal, the patient reported a significant increase in pain, marked by an inability to bear weight on the right lower extremity. She presented to an outpatient physical therapy clinic with a referral from the orthopaedic physician. She ambulated with axillary crutches favoring her right leg in a nonweight bearing fashion with a Webly™ ankle orthosis (Hely and Weber, Santa Paula, CA) despite instructions from her physician to weight bear as tolerated. Written informed consent for treatment was obtained prior to evaluation and health care accountability and portability act guidelines were followed throughout

treatment. Prior to examination, a patient history was obtained (Table 1).

Clinical Impression One

The patient presented with pain disproportionate to the inciting event in the distal right lower extremity. This resulted in an inability to ambulate on the affected extremity.

EXAMINATION

The initial examination occurred with the mother present throughout. A student physical therapist (MP) with a clinical instructor performed the examination.

Pain Catastrophizing Scale for Children

The Pain Catastrophizing Scale for Children (PCS-C) is a patient questionnaire that is designed to capture patient beliefs with regard to pain catastrophizing.[12] The PCS-C consists of 13 questions and is scored from 0 to 52, with higher scores indicating greater levels of pain catastrophizing.[12] The PCS-C has been shown to be a stable and valid instrument with good construct validity in children.[12] A previous study used a PCS score of 21.1 to predict an increase in pain during physical activity in the chronic low back pain population.[13] The pediatric patient in this report scored 46/52 at the initial examination. The adult version of the PCS scale, which is similar to the pediatric version, has been used for research within the adult CRPS population.[9]

Tampa Scale of Kinesiophobia

The Tampa Scale of Kinesiophobia (TSK-17) is a 17-item patient questionnaire designed to capture patient beliefs of fear of movement and has shown to be a valid measure[14] within the chronic low back pain population. The TSK scale ranges from 17 to 68 with higher scores indicating greater levels of kinesiophobia. A previous study[14] showed that a score greater than 44.4 can predict self-report disability and poor behavioral performance in chronic back pain patients. The pediatric patient in this report scored 48/68 at the initial examination. The TSK-17 instrument has been previously used in studies of adult patients with CRPS;[9] however, this instrument has not been studied in children. Use of the TSK and PCS were used as a way to monitor pain beliefs throughout the course of therapy. At evaluation, this patient exceeded previously identified cut-off scores on both the TSK and PCS-C by 4 points and 15 points respectively.

Table 1. Initial Examination Findings – History and Self Report Measures

Subjective Complaints	Constant right ankle pain described as excruciating, pressure, throbbing, stiffness, and aching.
Pain Behavior	Nothing makes pain better, and movement and touch makes pain worse.
Prior Treatment	Daily ice baths Cast immobilization
Prior Level of Function	Dance team 5x per week, running at school, playing with friends.
Current Level of Function	Unable to walk to school, unable to put socks or shoes on, unable to participate in any physical activity at school or dance practice.
Goal	Decrease pain to 2/10, able to walk, and able to return to dance.
Pain Catastrophizing Score	46/52
Tampa Scale of Kinesiophobia	48/68 (Score from 17-68)
Lower Extremity Functional Scale	8/80

Numeric Pain Rating Scale

The Numeric Pain Rating Scale, is an 11-point scale designed to measure pain intensity.[15] Patients are asked to rate pain from 0 to 10 with zero being no pain, and 10 being the worst pain imaginable.[15] The Numeric Pain Rating Scale has shown good validity in children over 8 years old, and appears to be sensitive to change over time.[15] The minimal clinically important difference for the Numeric Pain Rating Scale in children has been reported to be one point.[15]

Lower Extremity Functional Scale

The Lower Extremity Functional Scale (LEFS) is a patient questionnaire used to quantify a patient's ability to participate in functional activities involving the lower extremity such as walking and running. The LEFS is a 20-item scale scored from 0 to 80 with higher scores indicating less perceived functional disability.[16] The test-retest reliability of the LEFS has been reported as excellent (r = .94)[16] and has been used within a clinical trial for pediatric patients with CRPS.[7] The minimal clinically important difference of the LEFS has been reported to be 9 points.[16]

Range of Motion and Manual Muscle Testing

Range of motion measurements were taken with a standard goniometer and manual muscle tests were performed on both lower extremities. The intratester reliability of active ankle range of motion measurement using a universal goniometer has been reported as moderate to high[17] (ICC = .82). The reported standard error of measurement and minimal detectable change (MDC_{95}) for goniometric ankle measurement has been reported as 3.7 and 7.4 respectively.[17] Manual muscle testing measurements were obtained for bilateral ankle dorsiflexion, plantar flexion, inversion, eversion, knee flexion, knee extension, hip flexion, and hip abduction. Manual muscle testing appears to have moderate intrarater reliability in children (ICC = .75).[18] Manual muscle testing and range of motion testing for the lower extremities were marked by patient reports of 10/10 pain with testing, visual grimacing, and crying.

Skin Temperature, Neurological Screening, and Edema Measurement

Skin temperature was assessed through hand palpation side to side by both the student physical therapist and clinical instructor with use of touch. A brief neurological examination including light touch sensation, vibratory sense, and deep tendon reflexes was performed. The inter-examiner reliability of sensitivity testing including light touch and vibration has not been well studied but is estimated to be moderate when the patient is positioned in supine.[19] Minimal edema was noted based on visual inspec-

tion and performance of figure eight edema measurement. The figure eight method of measurement for foot related swelling has been reported to be a reliable and valid testing measure with a $MDC_{95\%}$ of 7.3 mm with skin marking.[20] A complete listing of examination data obtained is shown in Table 2.

Clinical Impression Two

Temperature asymmetry, color asymmetry, mottling appearance to affected extremity were noted. In addition high levels of disproportionate pain, a history of immobilization, minimal edema, painful limited ankle range of motion, large decreases in muscle strength in the right foot and ankle with signs of muscle atrophy were also detected. The pain was diffuse in nature and not localized to a single area, and there was also sensory deficits in the right lower extremity with widespread allodynia to light touch. Based on the examination data the patient fit the Modified Budapest Criteria for CRPS type I.

INTERVENTION

The intervention program provided was a multimodal treatment approach consisting of a modified graded motor imagery program, tactile desensitization, therapeutic pain neuroscience education, and therapeutic exercise with a focus on pain tolerance, functional activities, and sport-specific exercises. The patient was seen 2 times per week for 5 weeks. Each session would begin with a modified graded motor imagery program with left/right discrimination tasks, explicit

Table 2. Initial Examination Findings – Physical Examination

Measure	Left Result	Right Result
Visual Inspection	Unremarkable	Red/purple color with mottling like appearance isolated to talocrural joint and below. Appearance of mild swelling around metatarsal bones. Calf muscle atrophy on right lower extremity.
Temperature	Same throughout lower extremity	Distal foot and ankle were considerably colder compared to left side.
Touch	Unremarkable	Entire foot and ankle showed allodynia to light touch. Patient was unable to describe the source of emanation of pain.
Palpation	Unremarkable	Soft calf musculature, deep pressure to calf was less painful than light touch to dorsum of foot. Palpable dorsal pedis and posterior tibialis pulse.
Neurological Examination	Light touch and vibratory sensation intact	Light Touch L2-S1 –impaired Vibratory Sense – L2-S1 – impaired
Ankle ROM	Dorsiflexion/Plantar Flexion AROM: WNL	Plantar Flexion AROM 45 to 55° Inversion/Eversion 5°/9° Total sagittal AROM of ankle was 10. Patient unable to produce active dorsiflexion. Any movement of ankle caused 10/10 pain, facial grimacing, and crying.
Knee ROM	WNL – testing of left side was associated with pain on the right side	Extension/Flexion AROM: 0°-106° Movement of knee joint also provoked pain response
Hip ROM	WNL	Flexion: 90° Abduction: unwilling to abduct past 3° due to pain response.
Ankle MMT	WNL provoked pain response felt on right ankle	Dorsiflexion: 2- Plantar Flexion: 2- Eversion: 1/5 Inversion: 1/5
Knee MMT	WNL provoked pain response felt on right ankle	Extension: 3/5 Flexion: 3-/5
Hip MMT	WNL	Flexion: 3-/5 Abduction: 3-/5
Figure 8	448 mm with skin marking	454 mm with skin marking

Abbreviations: ROM, range of motion; AROM, active range of motion; WNL, within normal limits; MMT, manual muscle testing

motor imagery, and mirror therapy in that order. Tactile desensitization followed mirror therapy finally concluding with therapeutic exercises focusing on progressive loading of the right ankle. Sport-specific exercises were included toward the end of the program to help with the return to sport transition. Therapeutic exercises typically increased the patient's pain initially but would subside over the course of the treatment session. Education regarding increases in pain not corresponding to new damage was crucial before more aggressive exercises were implemented and was provided extensively throughout the first 3 treatment sessions. Exercises continued regardless of increases in pain, and a graded progressive pain exposure philosophy was followed for all interventions. Table 3 has a brief description of the types of interventions as well as a description of the phases of therapy, rationale for progression, and key criteria that were used to progress.

Modified Graded Motor Imagery Program

A graded motor imagery program[8] is a sequence of non-overlapping, 2 week stages of 3 distinct motor imagery tasks consisting of left/right discrimination, imagined movements, and mirror therapy. The motor imagery program provided to the pediatric patient in this study was a modified version of the program previously described by Moseley et al.[8] During every session, the patient received all 3 proposed graded motor imagery stages as separate tasks performed consecutively in the order suggested by Moseley[8] until the therapist believed the maximum benefit had been reached, at which point it was discontinued during daily session but encouraged to be continued at home as needed.

Left/Right Discrimination Tasks

Laterality discrimination tasks were provided using the Recognise (NOI Group; Adelaide City, South Australia) feet software.[21] The program is available in iPhone (Apple Inc; Cupertino, CA) and iPad (Apple Inc; Cupertino, CA) formats,[21] with versions available specific to hands or feet. When the program is run, patients are shown a series of 20 pictures of feet at a default rate of 5 seconds per image, and are asked to choose on the screen whether the image is of a left or right extremity. At the completion of the test, scores for accuracy and speed are summarized.[21] As a patient progresses through the application, the context, external environment, extremity posture, and time of day of the images can be adjusted to a higher degree of difficulty.[21] As a general guideline, response times that differ from side to side which are greater than 2.5 seconds and/or accuracy less than 80% are considered to be evidence of disruption in left/right judgements.[21] In patients with CRPS, response times have been shown to be longer when identifying pictures of the affected extremity compared to identifying pictures of the unaffected extremity.[21] The pediatric patient in this case study used the Recognise feet application at the start of every therapy session, and the accuracy and speed for each visit was recorded within the chart notes.

Imagined Movements

Imagined movements consisted of prompting the patient with visual and verbal cues to imagine movements and/or sensory textures of her feet. The patient's age was the primary factor in deciding whether this intervention would be suitable to use. Children can engage in motor imagery tasks from as young as 5 years old.[22] About 90% of children 9 years old are able to actively and accurately engage in motor imagery.[22] Further, children that are more active tend to have an increased ability to participate in motor imagery tasks.[22] The patient described in this case study was an 11-year-old female with a long history of practicing dance thereby making her an ideal candidate for the intervention.

Mirror Therapy

Mirror therapy consisted of the patient being positioned in long sitting while being asked to hold a mirror between her legs while observing the reflection of the unaffected limb. Each mirror therapy session would begin by asking the patient to only move the unaffected limb and simply observe the reflection of the unaffected limb in the mirror. The course of each daily mirror therapy session would progress to asking the patient to have both extremities perform a series of movement while observing in the mirror the unaffected limb reflection. The movements in the initial session were typically single plane motions while later sessions would progress to more coordinated multi plane movements (Table 3).

Tactile Desensitization

Tactile desensitization is an intervention in which a patient undergoes sensory stimulation through the use of various textures as a tactile stimulus such as towel rubbing, texture fabrics, and hand massage. Desensitization procedures have been included in the past in clinical trials of pediatric patients with CRPS.[6] Desensitization was provided as a progressive intervention over the course of therapy initially beginning with light hand massage, progressing to tolerating towel rubbing, and finally progressing through a number of different rough texture fabrics.

Therapeutic Neurophysiologic Pain Education

Therapeutic neuroscience pain education is an educational intervention in which patients are educated on pain processing physiology, using a variety of delivery methods, with the intent that such education may help modulate future pain responses.[23] Presenting neuroscience pain education requires a degree of practice and often requires the use of metaphors, diagrams, stories, pictures, and handouts.[23] Within the pediatric pain population, the clinical use of analogies and metaphors suitable for children has been emphasized.[23] For this patient, the implementation of neuroscience pain education occurred initially on the day of evaluation. Pain education was discussed in the framework of defining what pain is, differences between nociceptive pain and neuropathic pain, role of psychosocial factors on pain processing, and the importance of movement despite pain. Subsequent visits were further used to elaborate on the educational models presented. Use of analogies and stories were the primary methods used to relay information. We tested comprehension of material by having the patient explain what she learned to her mother and on subsequent visits to the supervising physical therapist. Any neuroscience education would always occur after administration of PCS-C and TSK-17 so as to not exert a short-term influence on the results of those tests.

Therapeutic Exercise

Several different types of therapeutic exercises have been used in research trials for pediatric CRPS. Progressive weight bearing such as open and closed chain exercises,[7,10] aquatic therapies,[6] and cardiovascular exercise,[6,7] have all shown some promise in this population. In the trial by Sherry et al,[3] land-based therapeutic activities included jumping activities, running up and down stairs, various bilateral coordinated movements including use of mini-trampoline, age appropriate physical education, and sport drills. For this patient, her intervention program used many of the land-based therapeu-

Table 3. Intervention Phases

Type of Intervention	Phase One Week 1-2	Phase Two Week 3-4	Phase Three Week 5-6
Left Right Discrimination	Vanilla Feet in Recognise	Context Feet progressing to Abstract Feet in Recognise	D/C max perceived benefit reached
Tactile Desensitization	Dorsum of Hands, Silk Sheets	Progressing from towel to texture sticks to sandpaper	D/C abnormal sensation resolved
Explicit Motor Imagery	Imagined: postures, imagined walking on textured surfaces (grass)	Imagined: dancing, hopping, running on textured surfaces (sand)	D/C max perceived benefit reached
Mirror Therapy	Supine: Observing, 4 way ankle, ankle alphabet	Sitting or Standing: 4 way ankle, intrinsic coordination, toe fanning, circumduction	D/C max perceived benefit reached
Neuroscience Education *(Use of metaphors and analogies was necessary)*	Meaning of pain, nociceptive vs. neuropathic pain physiology, moving despite pain	Attention in pain, review of previous concepts	Review of previous concepts
Therapeutic Exercise/Activities *Manual assistance of minimal to moderate amount was needed for all activities until week 5* *Emphasis on progressive loading through functional engaging activities*	Gait training Toe walking Heel walking Tandem walking Compliant surface walking	Stair walking Manual assist treadmill training Trampoline mini jumps Tilt board Foam balance Glider disc walking Lunge progression Single leg stance progression	Floor ladder progression Hopping progression Jumping progression Single leg hopping Progression Plyometric drills Sport-specific dance drills
Key Criteria for Progression to Next Phase of Activities	Ability to weight bear with minimal gait deficit	Ability to perform single leg stance greater than 30 seconds unassisted	Ability to perform dance specific drills independently
Rationale Directing Choice of Interventions Within Each Phase	Changing pain behavior and pain beliefs	Normalizing side to side asymmetry in functional activities	Reinforcing return to prior level activities

Abbreviation: D/C, discharge

tic exercises as described by Sherry et al,[6] as well as general lower extremity strengthening and balance exercises. Activities in which the patient could be actively engrossed were thought to provide a cognitive distraction component and therefore possibly a greater benefit. A pain exposure based approach to therapeutic exercise was used to guide progression of interventions. Pain exposure based physical therapy consists of a progressive loading exercise program while simultaneously managing pain-avoidance behavior.[11] Using this approach, there is an emphasis on pain physiology education prior to initiation of exercises. Exercises are performed regardless of pain provocation and the therapist makes a conscious effort not to contribute to a patients' pain behavior. A complete listing of therapeutic exercises can be found in Table 3.

OUTCOME

Changes in Pain-related Outcome Measures

The patient was seen for a total of 9 intervention sessions over the course of 6 weeks. The TSK and the PCS showed their strongest reductions by the end of the third week of therapy. At discharge, the patient no longer exceeded cut-off scores on the TSK or PCS for prediction of future poor functional performance. The patient substantially exceeded the minimal clinically important difference reported for the Numeric Pain Rating Scale by 9 points. Figure 1 shows a graphical representation of pain-related outcome measures over time as a percentage of their respective scales.

Changes in Function Related Outcome Measures

Consistent with the self-report changes, significant gains in functional status were seen between weeks 3 and 4. Range of motion also improved significantly by week 3 and exceeded the reported MDC_{95} for active ankle range of motion by goniometric measurement by 38° or approximately 5 times the reported MDC_{95}.[17] At discharge, the patient substantially exceed the MCID reported for the LEFS by 60 points. Following discharge, the patient returned to dance painfree with no activity restrictions or limitations. Figure 2 shows functional related measures over time.

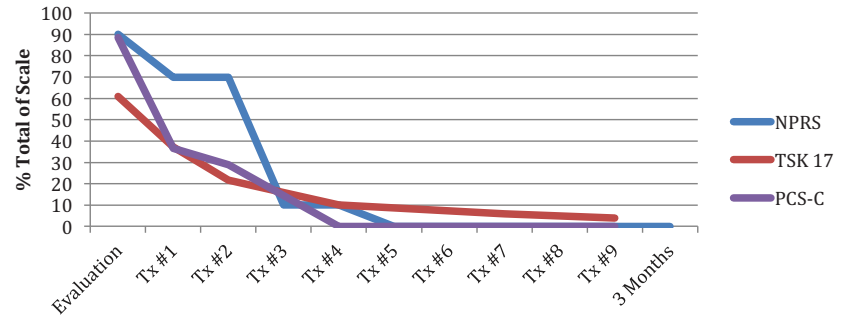
Follow-up

At the 3-month follow-up, the LEFS had only slightly decreased and was reported as

72/80. She reported transient 2/10 aching pain located at the Achilles tendon insertion following soccer practice. Pain remained at 0/10 at rest and with all activities of daily living. Since discharge, the patient had not experienced any reoccurrence of CRPS-like signs or symptoms.

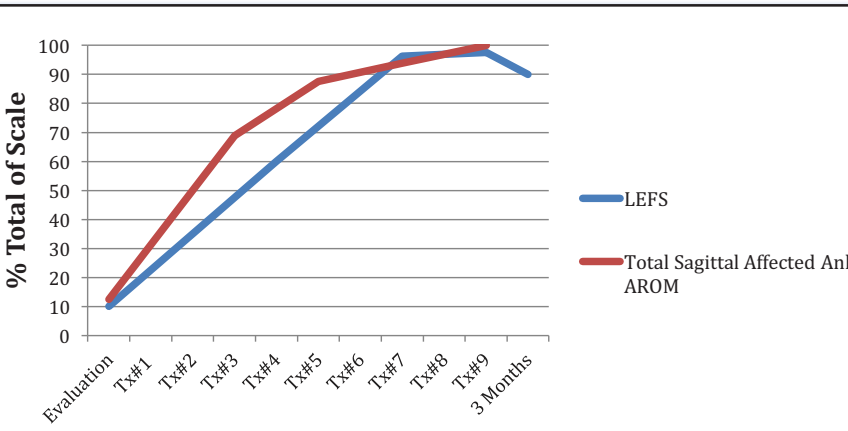
DISCUSSION

Our understanding of pain has shifted in recent years from a pathoanatomic to a biopsychosocial perspective in which pain is thought to share reciprocal relationships with physical, psychological, and socioeconomic factors.[24] This perspective has helped lead to the development of a number of cognitive behavioral approaches for neuropathic pain patients. More recently, use of visual feedback for pain modulation such as mirror therapy and graded motor imagery has become increasingly used in the treatment of patients with neuropathic pain syndromes.[8] Within both of these approaches, there is an emphasis on patient education regarding the neuroscience of pain processing.[7-10] This case described how both approaches could be adapted and used concurrently for a pediatric patient with a neuropathic pain syndrome. The pediatric patient reported in this case study appeared to have an excellent response to the multimodal treatment provided. Only a single published trial to date has examined treating pediatric CRPS under more typical practice conditions and found an average reduction of pain on a visual analogue scale of 5.6 points.[24] Previous studies have reported median recovery times of 6 to 7 weeks for pediatric patients with CRPS.[24] In contrast, this patient exhibited a decrease of 9 points on the Numeric Pain Rating Scale with the most rapid decreases occurring within the first 3 weeks. The reductions in pain beliefs following treatment seen in this pediatric patient were similar to those recently reported for other pediatric CRPS patients receiving multimodal outpatient treatment.[25] Several modifications were made to the graded motor imagery program. Typically graded motor imagery programs are provided in non-overlapping 2 week phases. However, a recent case series by Lagueux et al[26] modified the graded motor imagery protocol to provide imagined movements and mirror therapy together as well as progress mirror therapy over the course of treatment with acute CRPS patients. Lageux et al[26] speculated use of this modified program may be more clinically effective. For the pediatric patient in this case report, the program was continually progressed in response to patient feedback.



Abbreviations: NPRS, Numeric Pain Rating Scale; TSK-17, Tampa Scale of Kinesiophobia-17; PCS-C, Pain Catastrophizing Scale for Children

Figure 1. Changes in pain related measures.



Abbreviations: LEFS, Lower Extremity Functional Scale; AROM, active range of motion

Figure 2. Changes in function related measures.

Future Implications

Many of the interventions used with this patient have only been described in clinical trials with adult patients.[8,9,11] The positive response this pediatric patient had to treatment, with a quick recovery time, on an outpatient basis suggests further research using a similar approach may be warranted to see if similar results translate across a larger sample of acute pediatric CRPS patients. Guidelines in the pediatric CRPS literature have been published yet research regarding the ideal mix, dosage, and application of interventions to individual patients do not exist.[7] Research aimed at eliciting the specific mechanisms of therapy, ideal prescription, and treatment factors stand to significantly advance nonsurgical treatment of pediatric CRPS. With the significant heterogeneity of CRPS patients, it is also possible that subgrouping patients may further prove beneficial within a nonsurgical approach. Graded motor imagery including mirror therapy has been recommended for treatment of CRPS in adults.[19] Currently, no trials have been performed to study the efficacy of this approach in children.

Complex regional pain syndrome has been found to be associated with cortical reorganization within a number of sensory and motor cortices including the primary and secondary somatosensory, motor, posterior parietal, and supplementary motor.[8] Further, the amount of cortical reorganization has been shown to be correlated to CRPS symptoms, and when treatment is successful, cortical reorganization appears to reverse.[8] The findings suggest that CRPS pain symptoms may in part be a result of disrupted central processing and that graded motor imagery would help to restore the integrity of cortical processing and subse-

quently relieve pain. The developing brain has been considered by some to be more "malleable" and have a greater capacity for synaptic plasticity to occur.[27] This may help to explain the quicker treatment responses to exercise therapy that have been reported in children, which contrast with results from the adult CRPS literature. The increased potential for plasticity may also help to explain the higher reported reoccurrence rate seen only in the pediatric population. These considerations may suggest that a long-term approach to CRPS pain management may be needed for pediatric patients.

Complex regional pain syndrome patients may demonstrate an interaction between fear, kinesiophobia, and pain catastrophizing with self-report ratings of pain and disability.[24] Cognitive behavioral therapy hypothesizes that an individual's interpretation, evaluation, and beliefs about her health condition will affect the degree of emotional and physical disability experienced with that condition.[10] This patient had a simultaneous reduction in pain-related fear of movement, pain catastrophizing, and self-report pain levels during the course of treatment. For adult patients, it may be reasonable to attempt to explain pain physiology using actual neuroscience terminology. However, pediatric patients may lack the basic science knowledge to conceptualize the message given. For this patient, it was helpful to personify areas of the body and use real life situations that she could relate to in order to help explain the physiology. Cognitive behavioral therapy and pain neuroscience education may hold promise in addressing psychosocial factors for pediatric patients with CRPS.[10]

Limitations

The effectiveness of the current multimodal approach cannot be established based on a single case report. In addition, it is not possible to comment on any of the individual treatment components based on this case report. This patient was identified earlier than what is typically reported in the literature and it is unclear if the same responses would be found in chronic CRPS populations. The effect of natural history cannot be estimated from a single case study and it is unknown whether this patient would have recovered without intervention.

CONCLUSION

This case report described a multimodal treatment approach for a pediatric patient with CRPS that applied concepts and treatment approaches that have primarily been described for adult patients with CRPS. The patient responded well to a treatment plan consisting of a modified graded motor imagery program, therapeutic exercises guided by a pain exposure philosophical approach, tactile desensitization, therapeutic neuroscience education, and sport-specific exercises. The results of this case study may help to direct future research for pediatric CRPS nonsurgical treatment.

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Physical Therapy Following Reverse Total Shoulder Arthroplasty for a Patient with Anterior Shoulder Pain: A Case Report

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ABSTRACT

Background and Purpose: A reverse total shoulder arthroplasty (rTSA) can result in improved function and pain for patients with shoulder arthropathy. This case report describes the postoperative rehabilitation of a patient with complications of continued acute pain and bicipital tendinopathy using clinical decision making to modify an evidence-based protocol. **Methods:** A 79-year-old female patient was seen initially at 12 weeks postoperative following an rTSA. Evaluation findings indicated concurrent biceps tendon pathology. Care followed the Brigham and Women's Hospital rTSA protocol with modification of exercises for the biceps tendinopathy. **Findings:** At discharge 24 weeks postop, the patient had improved pain, range of motion, and strength, allowing for improved function of the shoulder, demonstrated by improved scores on the Shoulder Pain and Disability Index. **Clinical Relevance:** This case report demonstrates the use of clinical criteria for modification and progression of interventions in a patient with postoperative complications.

Key Words: rTSA rehabilitation, biceps tendon, Shoulder Pain and Disability Index

BACKGROUND

Shoulder arthropathy describes the degenerative changes that occur to the humeral head as a result of the superior translation of the humerus in the rotator cuff deficient shoulder.[1] A pseudo paralysis often occurs with shoulder arthropathy secondary to the pain and weakness that occur at the glenohumeral joint. Traditional shoulder arthroplasty has resulted in poor outcomes in the management of shoulder arthropathy. Superior migration of the humeral portion of the prosthesis and glenoid loosening can occur without the stabilizing forces of the rotator cuff.[2,3] The reverse total shoulder arthroplasty (rTSA) is a viable surgical option for patients suffering from shoulder arthropathy.

In 1985 Paul Grammont designed the reverse shoulder prosthesis. It is termed reverse shoulder prosthesis because the humeral component is a concave socket, while the glenoid component is a base plate with a glenosphere. The altered biomechanics of this shoulder prosthesis moves the center of rotation medially and inferiorly, creating a mechanical advantage for the deltoid muscles. By increasing the recruitment of and tension on the deltoid, it is able to compensate for the lacking rotator cuff during shoulder elevation.[2,4] Improvements to the original design proposed by Grammont have led to positive outcomes for patients undergoing a rTSA. With the deltoid as the primary elevator of the shoulder, patients can typically elevate the upper extremity above the level of the shoulder without pain and perform functional activities well below shoulder height.[3,5]

Surgical technique and appropriate postoperative care are important factors for favorable outcomes in the rTSA. The patient must possess sufficient cognitive abilities to understand the expectations for the rTSA and potential complications. Progression of movement postoperatively must be monitored to prevent complications. Outcomes for the rTSA have improved since it was first introduced; however, it has complications with rates as low as 2% and as high as 50%.[3,5,6] A recent systematic review on rTSA by Smith, Guyver, and Bunker[6] identified 5 significant surgical complications occurring with the rTSA: dislocation, infection, glenoid loosening, acromial fractures, and scapular notching. Scapular notching is a complication specific to the rTSA, in which the glenoid cup impinges the scapular neck and causes resorption of the lateral pillar of the scapula.[4,6] This has been reported in greater than 50% of cases.[4]

Patients, who have undergone rTSA secondary to shoulder arthropathy, function preoperatively with compensatory movement strategies using the scapulothoracic joint.[7] An altered scapular kinematic of increased upward rotation is frequently seen in patients with full thickness rotator cuff tears.[8] While there is some evidence that the altered scapular kinematics may assist in shoulder elevation in rTSA, it may also be contributing to complications in postoperative recovery.[7] The increased scapular rotation can contribute to scapular notching because of contact between the prosthesis and the border of the scapula while lowering the arm.[7]

Scapular dyskinesis has been linked to glenohumeral pathologies and conditions such as impingement and instability. Shoulder impingement includes compression, entrapment, or irritation of either the rotator cuff structures or the long head of the biceps tendon.[8] Based on the current literature, it is reasonable to believe that altered scapular kinematics can also lead to pathology with a prosthetic shoulder. A study by Tuckman and Dines[9] identified pathology of the long head of the biceps tendon as a complication of traditional shoulder arthroplasty. In this study, tearing and scarring of the long head of the biceps tendon was found during shoulder arthroscopy of patients that continued to have anterior shoulder pain and catching after total shoulder arthroplasty.[9] The long head of the biceps tendon is highly innervated and can be a source of pain when inflammation, degeneration, or instability of the tendon within the bicipital groove is present.[10] It is important that the rehabilitation process for standard and rTSA includes retraining of the muscles surrounding the glenohumeral and scapulothoracic joints to ensure optimal motion and reduce the risk of inflammation at the shoulder.[7,9]

The patient, surgeon, and physical therapist must all understand the outcome expectations for rehabilitation and function, as well as the unique biomechanics of rTSA.[3,5,11] Boudreau et al[5] published guidelines for rTSA rehabilitation in 2007 based

on 3 important concepts: joint protection, deltoid function, and appropriate expectations for motion and function. The high risk of dislocation with the rTSA means the patient must understand the position of dislocation for a rTSA is extension combined with internal rotation, such as occurs when performing personal hygiene. Avoiding this position for the first 12 weeks postoperatively is important.[5,12] Understanding the biomechanics of the rTSA ensures therapeutic exercises focus on strengthening the deltoid and periscapular muscles in order to achieve functional elevation of the upper extremity. The focus of the rehabilitation process should be to improve functional elevation, while respecting the postoperative expectation of less than full elevation.[5]

Based on Boudreaus's guidelines, The Brigham and Women's Hospital Rehabilitation Department Reverse Total Shoulder Arthroplasty Protocol[12] advocates for an evaluation based method of progression through the protocol predicated on healing time frames, clinical presentation, and complication risks.[12] The protocol is broken into 4 phases. Phase I: The Immediate Postsurgical Phase/Joint Protection (Day 1 – 6 weeks), Phase II: Active Range of Motion/ Early Strengthening (Week 6-12), Phase III: Moderate Strengthening (Week 12+), and Phase IV: Continued Home Program (Week 12+).

The purpose of this case study is to discuss interventions aimed at optimizing the biomechanics and postoperative healing of the rTSA in a patient with pain beyond the acute phase of healing. By focusing on the previously mentioned concepts and following the principles of rehabilitation progression based on clinical criteria, optimal outcomes for the patient with a rTSA occurred.

CASE DESCRIPTION

The patient is a 79-year-old female seen in outpatient physical therapy for an initial evaluation 12 weeks status post left rTSA. The patient elected to have the surgical procedure because of pain and functional limitations. Her quality of life was being affected by the shoulder arthropathy and pseudo paralysis due to a dysfunctional rotator cuff. Her age and the functional demands of her shoulder made her a good candidate for a rTSA. The patient's past medical history included multiple orthopaedic and medical conditions, none of which were considered exclusionary for the surgery or limited rehabilitation. Patient was left hand dominant because of a chronic right rotator cuff tear. Her prior level of function was independent with all activities of daily living (ADL) and household tasks such as cooking. She used a straight cane for ambulation.

A Zimmer Trabecular Metal Reverse Shoulder Implant (Zimmer Inc, Warsaw, IN) with a standard base plate was inserted through a deltopectoral interval incision while the deltoid muscle was retracted. At the time of surgery the supraspinatus, infraspinatus, and subscapularis were found to be irreparably torn. After placement of the prosthesis, the prosthesis and musculoskeletal structures were found to be stable throughout range of motion. The shoulder was immobilized following surgery.

The physician selected immediate postoperative protocol restricted shoulder range of motion for 6 weeks. The patient wore a sling except during bathing and elbow /hand range of motion. Additional restrictions for the first 6 weeks postoperative included no lifting with the operative arm, no weight bearing on the operative arm, and no motion of the arm behind the body. At her 6-week follow-up with the surgeon, the sling was discontinued and she was given a home exercise program (HEP) by the physician. Whether the HEP was demonstrated to the patient with guidance is unknown. The HEP included pendulum exercises, scapular retraction, supine elevation and wall walks. The patient performed these exercises independently, gradually adding weight up to 2 pounds over time.

At her 3-month follow-up visit with her surgeon, she was able to perform elevation to 70°, which was less than her preoperative range of motion. She also reported anterior shoulder pain at 6/10 on a visual analog scale (VAS). Radiographs of the left shoulder showed no periprosthetic fractures or scapular notching. The physician referred the patient to physical therapy with instructions to work on scapular stabilization, active assisted and active range of motion for forward elevation of the shoulder, and elbow stiffness. The physician's restrictions for physical therapy included no internal or external rotation work with the shoulder and no resistive strengthening greater than 10 pounds.

Examination

The Shoulder Pain and Disability Index (SPADI) questionnaire was chosen as the outcome measure due to the ability to measure the impact of shoulder pathology on pain and disability, with subscales for each.[1] The SPADI has also been shown to have high construct and longitudinal validity in measuring change of a patient's pain and disability over time.[13,14] The minimal clinically important difference, which represents the smallest change in score that is considered important, is 8 points. The minimal detectible change (MDC_{95}) in scores at initial evaluation and discharge is 18 points.[15] The SPADI consists of 13 items under the subscales of pain and disability. Patients are asked to rate their pain or difficulty from 0 to 10. Scores are calculated for each subscale by adding the item scores and dividing by the maximum score possible. The total score is calculated by averaging the two subscale scores, a lower score indicates less pain and disability and thus greater function.[13] The patient's score at initial evaluation was 78% for the pain score, 63% for the disability score, and a total score of 71%.

Functional limitations were identified as ADLs including dressing, bathing, and grooming. She had not been able to perform any meal preparation activities since surgery due to pain with lifting and reaching. The patient was experiencing significant sleep disturbances, with as much as 4 to 6 hours of sleeplessness per night. She rated her current resting pain as a 4/10 on a VAS. Pain was localized to the anterior aspect of the shoulder, with occasional radiation of pain into the biceps muscle. She reported that her pain was often at an 8/10 during and after activity including self-care and her exercises.

Systems review showed resting blood pressure of 135/70 and heart rate of 70 beats per minute. Visual inspection of her skin revealed a well healed scar on the anterior aspect of her left shoulder. There was no visible bruising or edema present at the left shoulder or elbow. Sensation was intact in bilateral upper extremities and left lower extremity. However, diminished sensation to light touch and numbness and tingling were present in the right lower extremity. The musculoskeletal review of the noninvolved extremities showed limited active motion and strength in the right shoulder (Tables 1 and 2). Active range of motion of the right elbow, wrist, and bilateral lower extremities was found to be within functional limits.

Evaluation of the left involved extremity showed significant tenderness and muscle guarding throughout the left upper trapezius, levator scapula, biceps tendon, and biceps muscle belly during palpation. The patient held the left upper extremity in a guarded position of shoulder elevation and internal rotation, with the elbow

Table 1. Goniometric Measurements in Degrees

	Right		Left			
Shoulder Motion	Initial AROM	Initial PROM	Initial AROM	Initial PROM	Re-eval AROM	Final AROM
Flexion Supine	45	90	150	155	160	165
Flexion Sitting	30	NT	75	NT	90	95
Abduction	30	80	45	75	75	90
External Rotation	10	30	0	10	15	35
Elbow Extension	0	0	-20	-10	0	0

Abbreviations: AROM, active range of motion; PROM, passive range of motion, Re-eval, re-evaluation

Table 2. Manual Muscle Testing Measurements

	Right	Left		
Shoulder Motion	Initial MMT	Initial MMT	Re-eval MMT	Final MMT
Flexion	3/5	3/5	3+/5	4-/5
Extension	4-/5	3+/5	4-/5	4/5
Abduction	3/5	3+/5	3+/5	4-/5
External Rotation	3/5	3+/5	3+/5	3+/5
Elbow Flexion	4+/5	4-/5	4/5	4+/5

Abbreviation: MMT, manual muscle test; Re-eval, re-evaluation

flexed and forearm held tight to her abdomen. Her left scapula was protracted and upwardly rotated. Resting posture showed forward head and bilateral forward rounded shoulders.

Active range of motion (AROM) and strength were assessed in both supine and sitting (Table 1). Limitations in bilateral shoulder elevation and left elbow extension were noted. Strength was assessed through manual muscle testing, using a 0-5 muscle grading score and standardized positions described by Kendall & McCreary[16] (Table 2).

At the time of the evaluation the patient was 12 weeks postoperative, yet continued to have high pain levels causing functional limitations. The therapist reasoned that this was not a normal course of recovery and there was an underlying pathology causing pain. The patient's localized pain and tenderness over the biceps tendon led to the performance of special tests at the biceps in order to establish a differential diagnosis for the source of the pain. A Speed's test for biceps tendonitis was performed and found to be positive. The Speed's test was performed with the patient's arm elevated to 90°, with the elbow extended to the end of the patient's elbow AROM. Resistance was given distal to the elbow in the direction of shoulder extension. Pain at the bicipital groove indicated a positive test.[17] A 1998 study by Bennett found the Speed's test to have high sensitivity (0.90) and low specificity (0.14) for biceps tendon pathology.[18] More recent studies on specificity of the Speed's test have found it to have high specificity (0.83-0.86) and a low sensitivity (0.23-0.36).[17]

The Upper Cut Test was also performed due to its high sensitivity (0.77) and specificity (0.88) for bicep tendon lesions. This test was performed with the patient's shoulder in neutral, elbow flexed to 90°, forearm supinated, and hand in a fist. The patient was instructed to punch up in an upper cut motion, bringing her fist towards her chin. Resistance to this motion was given at the hand. Pain over the anterior aspect of the shoulder during the resisted motion indicated a positive test.[17] The combination of these two tests have been shown to have a high positive likelihood ratio, suggesting a high likelihood of biceps tendon pathology in this patient.[17]

Diagnosis and Prognosis

Data gathered from the patient's history and examination was used to establish a plan of care. Consideration of the shortened biceps muscle, localized pain to the anterior aspect of the shoulder, and positive special tests, led to an initial clinical impression that the patient's high pain levels at 12 weeks postop were a result of biceps tendonitis. The therapist reasoned that improper performance of the home exercises using the biceps muscle to perform the movements rather than initiating scapular stabilizer muscles had led to an overuse tendonitis.

This opinion was supported by evidence indicating complications of the long head of the biceps tendon pathology after standard total shoulder arthroplasty.[9] The patient's poor shoulder and scapula positioning at rest and painful exercise supported clinical reasoning that the biceps tendon was most likely being compressed during left upper extremity elevation, leading to inflammation and pain. Based on the Nagi model of disablement, the pain and inflammation were impairments leading to the functional limitations reported by the patient.[19]

The plan of care was established during the initial episode of care and focused on reduction of inflammation, while improving painfree movement. Treatment goals are presented in Table 3. The prognosis for this patient to meet these goals and have a good outcome was good, based on the fact that previous studies had shown good outcomes in regards to pain and function when an rTSA is performed in patients with rotator cuff arthropathy.[3]

Intervention

The Brigham and Women's Reverse Total Shoulder Arthroplasty Protocol[12] was selected as a general guideline for the rehabilitation program of this patient. This protocol aligned with all physician ordered

limitations. The protocol is based on current literature and provides clinical indicators for progression. Timelines given in the protocol are examples and not used for patient progression.[12] While the patient was 12 weeks postoperative at the time of the evaluation, the patient's pain levels indicated that she was functioning in Phase I of the Protocol. Treatment began with a focus on decreasing pain and inflammation in the biceps tendon and improving biomechanics of shoulder elevation.[20] Clinical decision making would suggest that by addressing these impairments first the patient would be able to decrease pain and improve motion in the left upper extremity, before progressing through the subsequent phases of the protocol.

Intervention began on the day of the initial evaluation to focus on modifying the patient's current home exercises. The patient demonstrated the exercises which she had been performing for the past 6 weeks. She complained of pain with all the exercises. She also demonstrated upper trapezius substitution and veering of the upper extremity into horizontal abduction with elevation. Tone in the biceps was maintained throughout all exercises. She was unable to fully extend her elbow.

A modified home exercise program was developed with the goal of improving the position of the scapula and improving the length of the biceps. Active bicep curls and external resistance exercises were discontinued and replaced with a passive biceps stretch in supine. The patient was instructed to keep the exercises painfree and to work to fatigue, twice a day. The exercises were monitored to make sure that proper technique was used in order to avoid pain.[5] The patient was instructed on proper postural alignment at rest and during activities. Cryotherapy post exercise and at bedtime to reduce pain was recommended.[5]

At the second visit, cross friction massage to the biceps tendon began and continued for 6 visits. This was performed in conjunction with active ROM, passive ROM, and stretches for elbow extension to improve the length of the biceps and normalize biomechanics at the elbow and shoulder. This intervention was discontinued when the patient was able to fully extend her left elbow without pain. As the patient's pain subsided, the focus of the rehabilitation shifted to strengthening. After 3 weeks of physical therapy (15 weeks postoperative), the patient's pain decreased to 0/10 resting pain. The highest pain levels of 7/10 were reported in the morning, if she slept on her stomach.

Table 3. Physical Therapy Goals

Short-term Goals 4 weeks
1. Patient to report episodes of 2/10 resting pain to facilitate falling asleep.
2. Patient will be able to actively elevate the left upper extremity to 90° against gravity to facilitate activities of daily living such as washing her hair.
3. The patient will be able to fully extend her elbow to facilitate reaching with an outstretched arm.
Long-term Goals 12 weeks
1. Shoulder Pain and Disability Index to be less than or equal to 30% demonstrating improved functional abilities.
2. Patient able to perform dressing activities independently, with pain less than or equal to 2/10 in the left shoulder.
3. The patient will be able to elevate her left upper extremity to 110° without pain to facilitate light meal preparation in her kitchen.
4. Patient to report no sleep disturbances secondary to left shoulder pain.

At this point, gentle strengthening was initiated using the guidelines of Phase II of the protocol. Pain levels with activity and exercises, as well as the patient's ability to perform the exercise with proper technique, were used as criteria to progress the patient's program. All of the exercise focused on improving strength of the deltoids and periscapular muscles for improved scapular kinematics and function of the left arm.[21,22] Table 4 shows the exercises performed in the clinic, timeframes, and the progression over Phases I – III. A cold pack was placed on the patient's shoulder for 15 minutes after intervention in the clinic during Phase I and Phase II of rehab to decrease post exercise soreness, swelling, and limit the development of inflammation.[5]

At 24 weeks post-op, the patient met the criteria for discharge listed in Phase IV of the rehab protocol. Criteria for discharge included the patient's ability to maintain painfree active ROM in elevation and external rotation with proper mechanics and capability to complete light household and work activities.[12] At the time of discharge the patient's total SPADI score was 19%, with subscale scores of 28% for pain and 13% for disability (Table 5). The patient was educated in proper progression of the home exercise program and instructed to continue with the exercises that are starred in Table 4. The long term lifting limitation of 10 pounds was also emphasized at the time of discharge.

Outcomes

Following the resolution of the biceps tendonitis at 15 weeks post-op, the patient made steady gains with physical therapy during recovery from her rTSA. Her pain levels decreased significantly over the first 3 weeks of intervention, allowing her to begin strengthening to improve her upper extremity function. Pain at rest went from a 4/10 to a 0/10 on the VAS. Her SPADI scores improved by more than the MDC each time the patient completed the SPADI prior to discharge (Table 5). The patient met all of the long term goals set at the initial evaluation and was able to return to functional activities such as cooking and light housework. A one-year postsurgery SPADI indicated maintenance of functional ability since discharge from physical therapy.

The patient's progression in recovery following the rTSA was extended due to the biceps tendonitis. Progression to Phase II exercises are normally begun at week 12 rather than week 15 in this case. Discharge to a home/community based program is expected at 16 weeks rather than 24 weeks. The complication of biceps tendonitis resulted in extension of the patient's disability of approximately 8 weeks.

DISCUSSION

This case demonstrates how using criteria based progression protocol through the postoperative rTSA phases allowed for positive outcomes despite complications

Table 4. Therapeutic Exercise Intervention: Progression of Exercise Repetitions (reps) and Resistance by the Phases of the Reverse Total Shoulder Arthroplasty Protocol

Exercises Performed	Phase I: Improvement in active range of motion and pain 12-15 weeks post-op	Phase II: Early Strengthening 15-20 weeks post-op	Phase III: Moderate Strengthening 20-24 weeks post-op
Supine shoulder elevation*	10-15 reps	2 lbs 10 reps to 2 x 10 reps	2 lbs 2 x 10 reps to 3 lbs 3 x 10 reps
Supine punch up*	10-15 reps	2 lbs 10-15 reps 2.5 lbs 10-15 reps	2.5 lbs x 15 reps to 3 lbs 2 x 10 reps
Supine shoulder press	10-15 reps	discontinued	discontinued
Supine elbow extension/ biceps stretch	30-second hold, 3 reps	discontinued	discontinued
Wall walks*	5-10 reps	10 reps	10-15 reps
Isometric shoulder flexion	5-second hold 10-15 reps	5-second hold 15 reps	discontinued
Resisted scapular retraction*	red Thera-Band tubing 10-20 reps	green Thera-Band tubing 2 x 10 reps to yellow Thera-Band 10-15 reps	yellow Thera-Band
Supine scaption	10-15 reps	2 lbs 10-15 reps to 2.5 lbs 10-15 reps	discontinued
Elevation in lawn chair position	to 30° of elevation 10 reps	45° of elevation 0 lbs x 15 reps to 2 lbs x 15 reps	90° of elevation 2 lbs x 15 reps to 3 lbs x 10 reps
Bicep curls*		3 lbs 10-15 reps to 4 lbs 15 reps	4 lbs 10-15 reps to 7 lbs 10 reps
Rolling physioball on table in standing position		rolled ball to 100° of shoulder elevation 10-15 reps	discontinued
Supine rhythmic stabilization at 90° shoulder elevation		30-second hold x 2 reps to 45-second hold x 2 reps	45-second hold x 2 to 60-second hold x 2
Standing scaption *		10 reps	2 x 10 reps to 3 lbs x 10 reps
Resisted scapular depression		yellow Thera-Band 10 reps	yellow Thera-Band 15 reps
Resisted shoulder extension with scapular retraction *		yellow Thera-Band 15 reps	yellow Thera-Band 2 x 15 reps to green Thera-Band x 15 reps
Resisted triceps		yellow Thera-Band 10-15 reps	yellow Thera-Band 15 reps to 2 x 15 reps

Table 5. Shoulder Pain and Disability Index Scores

SPADI	Initial Evaluation	Re-evaluation	Discharge	One Year Follow-up
Total Pain Score	78%	44%	28%	16%
Total Disability Score	63%	46%	13%	7%
Total SPADI Score	71%	45%	19%	12%
Abbreviation: SPADI, Shoulder Pain & Disability Index				

of biceps tendon pathology. The patient's signs and symptoms, including anterior shoulder pain beyond the acute postoperative phase led to a differential diagnosis of biceps tendinopathy. Using an evaluation-based progression to the interventions, the patient's postoperative care was based on the evidence and modified specific to her needs. Outcome measures showed clinically significant improvement in shoulder function with extended rehabilitation time.

Patients with shoulder arthropathy who undergo an rTSA can expect good outcomes with appropriate rehabilitation intervention. The optimal patient for an rTSA is over the age of 70, with low level demands of the upper extremity.[6,7] Patients typically have improved shoulder elevation and function with reduced pain following rTSA at 12 to 16 weeks.[3,7,12] The surgeon's technique and frequency of performing the procedure, as well as proper postoperative care including physical therapy, are important factors for positive outcomes.[3,11] This patient met all of these criteria therefore a positive outcome was expected. Yet, at the 3-month follow-up visit with her surgeon, she had continued pain on the anterior aspect of the shoulder and elevation against gravity limited to 70°. Given the amount of time since surgery, it would be expected that the patient could elevate her upper extremity to or above shoulder height.[5,7,12] Radiographs had ruled out common postoperative complications such as glenoid loosening, acromial fractures, and scapular notching as the source of the pain.[4,6] Improper exercise technique caused stress on musculoskeletal structures leading to biceps tendon pathology in addition to the postoperative impairments.

The initial evaluation included a differential diagnosis for the source of the anterior shoulder pain. Anterior shoulder pain is a typical symptom with biceps tendon pathology.[9,10] Anterior shoulder pain and catching has previously been discussed in the literature as a postoperative complication after traditional shoulder arthroplasty.[9] Positive special tests including the Speed's Test and Upper Cut Test confirmed involvement of the biceps tendon and a differential diagnosis of biceps tendonitis was made. By applying the conceptual Nagi scheme of disablement[19] to this case, the active pathology was identified, correlated to the remaining impairments at the shoulder, and addressed through intervention so that the functional limitations would improve.

Recent literature suggests that the while anterior shoulder pain has been previously diagnosed as biceps tendonitis, the term tendinopathy may be more appropriate. Tendonitis suggests that there is inflammation present, when often the tendon does not show changes consistent with inflammation. The changes resulting from overuse or irritation in the shoulder present as degenerative changes that can include things like altered collagen fibers and tendon thickening.[23] The term tendinopathy is more inclusive of a wider array of tendon conditions and would have been a more appropriate diagnosis for the source of the pain. A systematic review by Andres and Murrell[23] showed mixed results with physical therapy for tendinopathy. Eccentric biceps strengthening and glenohumeral joint mobilizations would have been appropriate interventions with support in the literature, but were not performed in this case. In this case, cross friction massage was performed to the biceps tendon to improve collagen alignment. We are unable to generalize this patient's episode of biceps tendon pathology after rTSA, but given that this type of complication has been documented in traditional shoulder arthroplasty, this may warrant further research.

The current literature on rehabilitation following rTSA advocates for protocols divided into 3 phases: protection, early motion/movement control, and moderate strengthening/functional rehabilitation.[5,7,12] The high rate of dislocation in the rTSA makes the protection phase of rehabilitation critical. The literature consistently advocates for protection of the joint for the first 6 weeks postoperatively.[3,5,7,12] The patient in this case report was not seen in physical therapy until 12 weeks postoperatively. The level of compliance with the protective phase of healing is unknown in this patient, which may have contributed to the pain levels and pathology present at initial evaluation. Poor quality and control of movement also contributed to this patient's anterior shoulder pain. The focus of Phase II of the protocol is movement control during early strengthening. An earlier referral to physical therapy would have allowed the therapist to ensure proper technique and neuromuscular control during performance of the physician prescribed exercises.

The third phase of the patient's rehabilitation focused on functional strengthening. The altered biomechanics, increased deltoid recruitment,[2,4] and increased contribution of the scapular thoracic joint to shoulder elevation[7,22] were considered during Phases II and III of the protocol. Technique was monitored during exercise, with special focus on the mechanics of the scapulothoracic and glenohumeral joints, to ensure prior poor mechanics were corrected. The clinical criteria for progression to the next phase of the protocol were used throughout the episode of care.

The progression of therapeutic exercise that focused on deltoid and periscapular strength resulted in improved function with decreased pain. The SPADI served as an appropriate outcome measure because of its ability to measure the impact of shoulder pathology on pain and disability, as well as detect change over time.[13,14] The minimal detectible change (MDC_{95}) in scores at initial evaluation and discharge is 18 points.[15] This patient had a change in her total SPADI score of 52. This correlated well with reports of improved functional abilities during ADLs.

CLINICAL APPLICATIONS

This case report describes the benefit of using clinical criteria for progression instead of time-based protocol. By using an evaluation-based method to advancing through the protocol, the patient was progressed only as criteria were met. This ensured that there was proper neuromuscular control of the unique biomechanics of the rTSA prior to increasing demand on the shoulder. This method of patient care allows the patient to receive evidence-based care in an individualized manner.

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Short-term Effects of Kinesiotaping on Pain and Function in Patients with Plantar Fasciitis

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ABSTRACT

Background and Purpose: There is a paucity of studies on Kinesiotaping in patients with plantar fasciitis. This case series evaluates the effectiveness of Kinesiotape on pain and function for patients with plantar fasciitis. **Methods:** Patients completed the Foot and Ankle Ability Measure (FAAM) and reported pain scores using the Numeric Pain Rating Scale (NPRS). Patients received Kinesiotaping and stretching for plantar fasciitis. Patients followed-up on day 3 and 14 after initial taping to evaluate pain with first steps, pain getting out of bed, and FAAM. **Findings:** On day 3, the mean improvement in NPRS scores for getting out of bed was 2.3 and 3.5 for pain on initial step; FAAM ADL scores and sports subscale improved 11.7 points and 7.0 points respectively. **Clinical Relevance:** Clinicians should consider Kinesiotaping to decrease pain and increase function while treating patients with plantar fasciitis. **Conclusion:** Kinesiotaping is effective in the short term, to improve pain and increase function in patients with plantar fasciitis.

Key Words: elastic tape, heel pain, physical therapy, intervention

INTRODUCTION

Plantar fasciitis is one of the most common causes of foot pain that affects nearly 2 million Americans annually.[1] It is estimated that plantar fasciitis affects 10% of the general population at some time during life.[2] Histopathologic research on plantar fasciitis finds no signs of inflammation, but rather reported degenerative changes in the plantar fascia.[3] Therefore, it has been proposed that this disorder can also be referred to as, plantar fasciosis.[3] For the purposes of this case series, the disorder will be referred to as plantar fasciitis. Anatomically, the plantar fascia is a thick fibrous, connective tissue band that originates in the medial calcaneal tuberosity and inserts into the plantar plates of the metatarsophalangeal joints, the base of the proximal phalanges, and the sheaths of the flexor tendon.[4] It plays an important role in providing foot support and rigidity throughout the gait cycle.[1,2,5,6] A widely accepted theory is that when weight bearing is increased to more than usual, there can be abnormal alignment or mechanics in the foot.[1,2,6] This abnormality into the foot can lead to repetitive trauma or stress that can irritate the plantar fascia at its origin on the calcaneus.[1,2,6] Other factors including high body mass index, improper footwear, decreased ankle dorsiflexion range of motion, high arches, excessive or prolonged duration of pronation, and history of prior foot injuries may contribute to the development of plantar fasciitis.[1,6] Patients may report insidious onset of pain under the plantar surface of the heel on weight bearing after a period of nonweight bearing.[7,8] Pain is typically exacerbated with periods of nonweight bearing such as the first steps after waking in the morning or after a period of inactivity.[5,9] Subjective history usually indicates a recent change in activity level, such as increased distance with walking or running or an employment change that requires more time standing or walking, or possibly changes in footwear.[7,8]

There are many nonsurgical treatments recommended for plantar fasciitis that include rest, stretching, orthotics, night splints, taping, ultrasound, cryotherapy, phonophoresis, and iontophoresis with dexamethasone.[5,10] It is suggested that 4 main goals for treatment of plantar fasciitis include (1) reduction of pain and inflammation to the fascia, (2) decreased stress to the fascia via external support to the foot, (3) strengthen extrinsic and intrinsic muscles of the foot, and (4) improve the extensibility of the gastrocnemius and soleus muscles.[11] Evidence at this time does not suggest one specific treatment approach for plantar fasciitis, although the above mentioned goals are important components for effective intervention.[11]

Taping as an intervention aims to address the underlying biomechanical problems of the foot.[12] In November 2014, a revision of clinical practice guidelines for heel pain were published by the Orthopaedic Section of the American Physical Therapy Association.[1] The 2014 recommendations for taping included using anti-pronation taping for immediate (up to 3 weeks) pain reduction and improved function for individuals with heel pain/plantar fasciitis, and using elastic therapeutic tape applied to the gastrocnemius and plantar fascia for short-term (1 week) pain reduction.[1]

Kinesiotape is a nonsurgical treatment option involving the placement of kinesthetic tape on the body to treat a variety of musculoskeletal conditions.[13] It is hypothesized that the tape activates the neurological and circulatory systems to help to relieve pain, prevent over-contraction, facilitate lymphatic drainage, and improve joint position and kinesthetic awareness.[13] There is limited data in the literature about the use of Kinesiotape with patients who have plantar fasciitis.[12,13] This case series studied the clinical significance on whether Kinesiotape had an effect in decreasing pain and increasing function in patients diagnosed with plantar fasciitis. We hypothesized Kinesiotape would decrease pain and increase function in patients with plantar fasciitis.

METHODS AND INTERVENTIONS

Subject Enrollment

Patients were referred to physical therapy from podiatric physicians with a diagnosis of plantar fasciitis or heel pain. To be considered for enrollment into the study, subjects had to fulfill all inclusion and exclusion criteria (Table 1). A total of 5 patients satisfied all inclusion and exclusion criteria and participated in this case series, which was conducted over the course of two years. This case series was approved by the Institutional Review Board at Brigham and Women's Hospital in Boston, MA. Patient privacy, patient consent, and compliance with Health Insurance Portability and Accountability Act (HIPAA) guidelines were maintained throughout the course of this case series.

Study Procedures

Patients underwent an initial physical therapy evaluation by a senior physical therapist (investigator 1) who had more than 5 years of outpatient physical therapy

experience. Investigators 2 and 3 collected objective data on the patients. As part of the study, each patient completed the Foot and Ankle Ability Measure (FAAM), inclusive of its two sections—the activities of daily living (ADLs) and Sports subscales. Patients reported pain using the Numeric Pain Rating Scale (NPRS), recorded by investigator 2 or 3. Both pain getting out of bed in the morning and pain with initial steps after sitting as a part of their daily activities were measured. Patients then received tape application by investigator 1, who is a certified Kinesiotape practitioner. The patient's skin was cleaned with an alcohol pad to remove superficial oils and dirt in an effort to effectively adhere the tape to the skin. The tape was measured and cut from 2 inches proximal to the toes on the dorsum of the foot, around the toes and under the foot and up to the distal one-third of the gastrocnemius muscle. Two button holes were cut into the tape where it passed over the 2nd and 3rd toes (Figure 1). Vertical slits were cut into the tape to create a fan over the portion of the tape that passed over the plantar fascia on its way to the calcaneus (Figure 2). The foot was held into neutral dorsiflexion for application of the tape (Figure 3). The anchor of the button holes were placed with paper off tension. The pieces of the fan were placed along the length of the plantar fascia with 75% tension. Then the tape continued over the Achilles tendon with 50% tension and as the tape passed over the musculoskeletal junction, 25% tension was applied on the tape. The tail end of the tape was applied up the gastrocnemius with paper off tension. Paper off tension describes applying the tape on to the skin with no more stretch than what already exists on the tape when the backing is removed. Percentages of tension on the tape were applied by investigator 1, by stretching the tape to its maximum and then backing off the tension to the determined percentage.

Patients were also educated on stretching for the plantar fascia and gastrocnemius. To stretch the plantar fascia, while sitting in a chair or edge of the bed, patients placed their hand over the toes and ball of the foot. Patients were educated to pull the toes and foot up towards them to feel a stretch into the bottom of the foot. The stretch was held for 10 seconds and repeated 10 times, performed 3 times a day. To stretch the gastrocnemius, patients were educated to stand on the edge of a step with both feet while holding on to the railing. They were to let the heels hang down over the edge of the step to feel a stretch into their calf muscle while keeping the knee straight. This stretch was held for 20 seconds and repeated 5 times, performed 2 times a day.[1]

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
• Unilateral foot pain with first steps when walking (greater than or equal to 3 on a 0-10 NPRS scale) • Pain with first steps when getting out of bed in the morning • Pain over the insertion of the plantar fascia or mid fascia with tenderness to palpation • Subjects over the age of 18 years • English-speaking	• Diabetes • History of foot fracture • Spasticity of the lower extremity • Lumbar radiculopathy • Systemic inflammatory diseases • Bilateral foot pain • History of calcaneal fracture • Open skin or a fresh scar • Allergy to tape, use of assistive device • Congenital deformity of foot an ankle • Pregnant women • Patients with impaired decision making

Patients were followed up on day 3 and 14 after initial tape application. Data was collected on pain with first step, pain when getting out of bed after initial taping, and FAAM were measured by investigator 2 or 3. Upon initial taping, patients were educated that the tape was to remain on the skin until at least day 3 follow-up. If the tape came off of the skin before day 3, the patient was no longer considered for the study. On day 3 follow-up, the patient's skin was inspected for signs of irritation from the tape by investigator 1. After this follow-up, the tape could be removed by the patient, any time after day 3 follow-up visit, per the patient's comfort. Two weeks (day 14) after the initial taping, patients returned to the clinic to gather information regarding reported measurements of pain with first step, measurement of pain when getting out of bed on day 14 after initial taping, and FAAM. The tape was not on the skin at day 14 follow-up.

After these final outcome measurements were obtained on day 14, patients were considered to have fully completed the study. They continued to be treated in physical therapy as clinically indicated.

Reliability and Validity of Measurement Tools

The FAAM was developed as a self-report evaluative instrument to comprehensively assess physical function of individuals with musculoskeletal disorders of the leg, foot, and ankle.[14] The FAAM consists of a 21-item ADL subscale and an 8-item Sports subscale. Each item is scored on a 5-point Likert scale anchored by 4 (*no difficulty at all*) and 0 (*unable to do*). A higher final score represents a higher level of function for each subscale.[15] Patients also completed a global rating of function scale at the end of each FAAM subscale and an overall categorical rating of function at the end of the FAAM. The patients rated their level of function with respect to ADL and Sports on a 0% to 100% level. Zero percent indicated an inability to perform the listed ADL or Sports tasks, whereas 100% reflected the level of function before injury.[15] The global rating score and the categorical rating of function were not included in the final total score for each subscale of the FAAM, and hence the data from each were not included for data analysis. In a diverse patient population, test retest reliability has been reported to be 0.89 and 0.87 for the ADL and Sport subscales respectively.[14] The minimal detectable change based on the 95% confidence interval was identified as ± 5.7 and ± 12.3 points for the ADL and Sports subscale.[14] The minimal clinically important difference (MCID) was 8 and 9 points for the ADL and Sports subscale.[14] The FAAM is a reliable, valid, and responsive measure of self-report physical function for individuals participating in physical therapy for musculoskeletal disorders of the leg, foot, and ankle.[14]

The NPRS is a pain scale used to measure the intensity of pain that adults experi-

Figure 1. Preparing the Kinesiotape.

Figure 2. Plantar view showing vertical slits in the tape.

Figure 3. Foot in neutral dorsiflexion.

ence.[16,17] The NPRS consists of an 11-point numeric scale with 0 representing no pain and 10 representing the worst pain the patient can imagine.[17] In this case series, the NPRS was a verbal report of pain, picking a number that best represents the patient's pain. Test-retest reliability of the NPRS is high at 0.96.[18] For a NPRS score to be deemed clinically important, the literature suggests a decrease of two points in the change score should be evident.[19]

CASE DESCRIPTION

A total of 5 patients met the inclusion and exclusion criteria, and participated in the study. One of the patients removed her tape prior to her first follow-up visit on day 3 and therefore was subsequently excluded from the study.

Patient 1

Patient 1 was a 49-year-old female with a diagnosis of left plantar fasciitis. She reported foot pain for 5 months with insidious onset. Radiographs confirmed evidence of a plantar calcaneal spur. The patient was not taking any non-steroidal anti-inflammatory drugs (NSAIDS) for her foot pain. On exam, strength in the evertor was 5/5 and the tibialis posterior strength was graded as 4+/5. Manual muscle test of the gastrocnemius was unable to be completed due to pain in the left foot with testing. Hip abductor strength was 5/5. She demonstrated a normal gait pattern on a level surface over a distance of 50 feet. The patient was recommended by her primary care physician to wear a tall walking boot for one week though; she was not compliant with this recommendation and did not wear the boot at all. Additionally, the patient reported that she wore a night splint intermittently.

Patient 2

Patient 2 was a 40-year-old male with a history of right foot pain for 3 months. His diagnosis of right plantar fasciitis was confirmed with MRI that demonstrated mild thickening and hyper-intensity in the middle bundle of the plantar fascia. The patient reported pain and stiffness when stepping with the foot on the ground when waking up in the morning. The patient was not taking any NSAIDs for the foot pain. On exam, the patient's strength on the manual muscle test (MMT) in the affected foot was 5/5 for evertors and 4+/5 for tibialis posterior and tibialis anterior. Hip abductor strength was 5/5. The patient did not demonstrate a gait deviation and was able to participate in short runs for exercise. The patient was wearing a night splint to help with symptom management and wore orthotics in his shoes.

Patient 3

Patient 3 was a 54-year-old female with a diagnosis of left plantar fasciitis. She reported foot pain for a period of 3 months, with intermittent symptoms. Two weeks prior to her physical therapy evaluation, she reported pain migrated to the lateral aspect of her foot as well. The patient reported pain when she first put the foot on the ground when waking up in the morning. On exam, she had tenderness to palpation over the medial inferior calcaneus and minimal increased tissue density over plantar fascia on palpation. Her strength in the affected foot assessed by MMT was evertors 4/5, tibialis anterior 5/5, and tibialis posterior 4/5. Manual muscle testing for gastrocnemius was limited by pain. Hip abductor strength was 5/5. Patient demonstrated an antalgic

gait pattern. The patient did not have medical images of her foot (ie, radiographs) nor was she taking any medication for her foot pain. Additionally, the patient was not wearing a night splint nor did she use orthotics in her shoes.

Patient 4

Patient 4 was a 31-year-old female with a diagnosis of right plantar fasciitis. She reported pain that started 6 months prior to the start of the study when she was walking for 9 hours with flat, nonsupportive shoes. The patient stated she felt the most pain when she moved from sit to stand. Upon initial evaluation, there was moderate tenderness over the medial, inferior calcaneus, though she was not tender over the midportion of the plantar fascia. The patient did not demonstrate an observable gait deviation or abnormality. Her strength in the affected foot assessed by MMT was evertors 5/5, tibialis anterior 4+/5, and tibialis posterior 4+/5. She had hip abductor weakness on the affected side with a MMT score of 4/5. The patient was able to complete a bilateral heel raise without symptoms, though she was unable to perform unilateral heel raises secondary to pain. No medical imaging studies were performed on her foot. The patient was taking NSAIDs for the foot pain; she did not wear orthotics.

OUTCOMES

Four Caucasian patients (age = 43.5 years ± 10.2, range = 31 – 54; body mass index = 32.9 ± 8.6, range = 25.9 – 45.4) with plantar fasciitis were taped and followed for 14 days. Three out of the 4 subjects were females (75%). The demographic information and their ankle ROM is described in Table 2.

The NPRS pain (Figures 4 and 5) and FAAM scores (Figures 6 and 7) were measured on day 1, 3 and 14. All dependent measures improved from day 1 to day 3 (Table 3). Similarly, all measures regressed when comparing day 14 to day 3. With the exception of the FAAM Sports subscale however, all dependent measures remained better on day 14 compared to day 1 (Table 3).

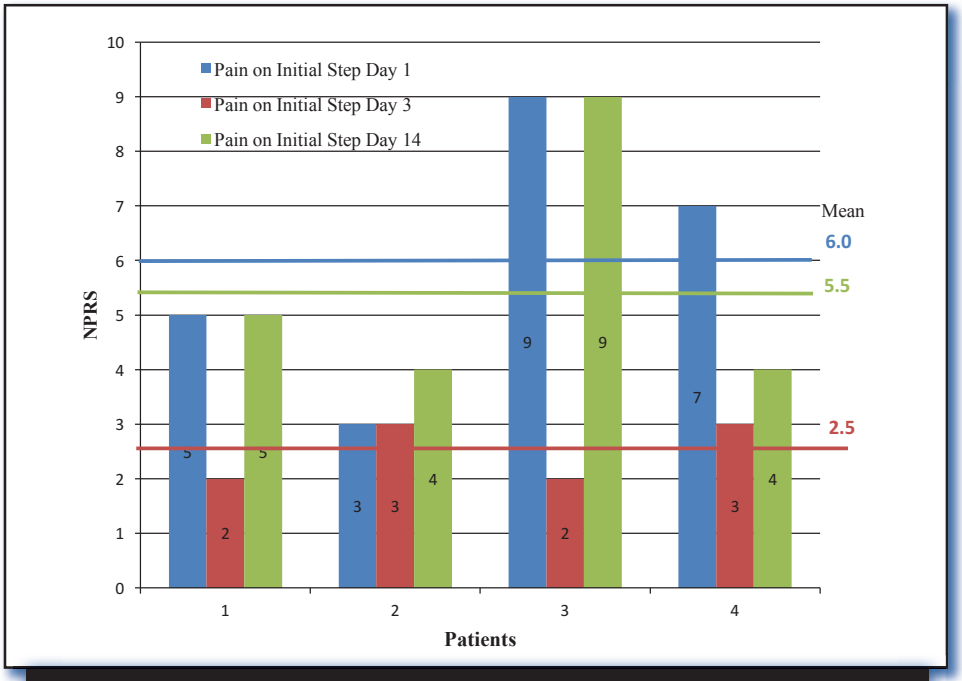

Figure 4. Pain scores for pain with initial step.

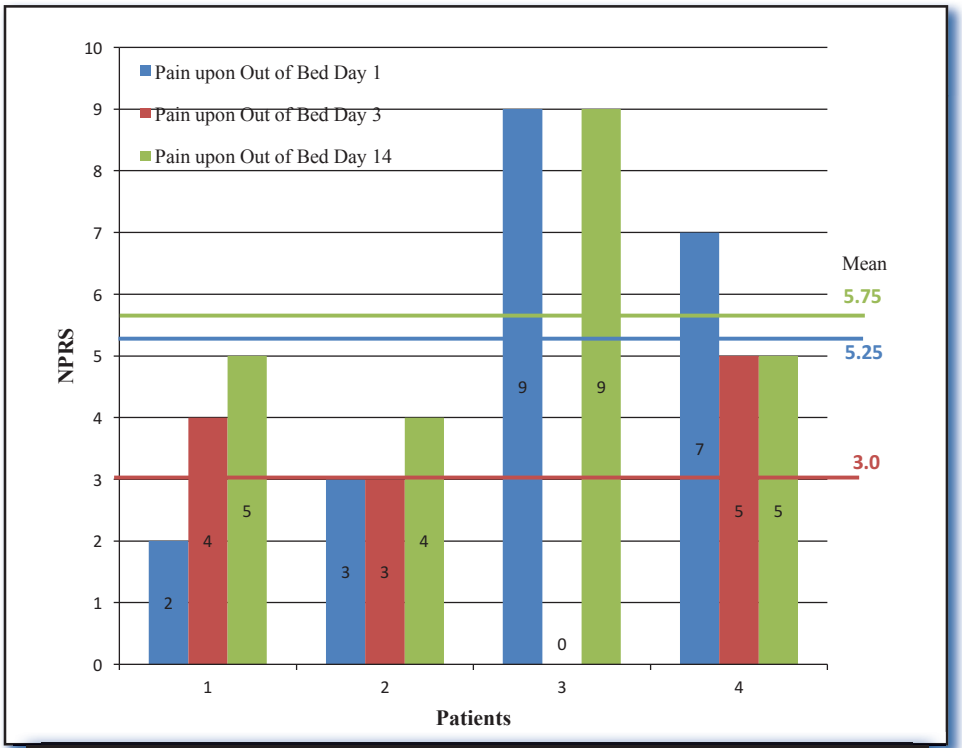

Figure 5. Pain scores for pain getting out of bed.

Table 2. Demographic Information of Patients

Patient	Age	Sex	Side Affected	Body Mass Index	PROM Dorsiflexion	AROM Dorsiflexion
1	49	Female	Left	31.5	15°	10°
2	40	Male	Right	25.9	12°	9°
3	54	Female	Left	29	10°	5°
4	31	Female	Right	45.4	10°	10°

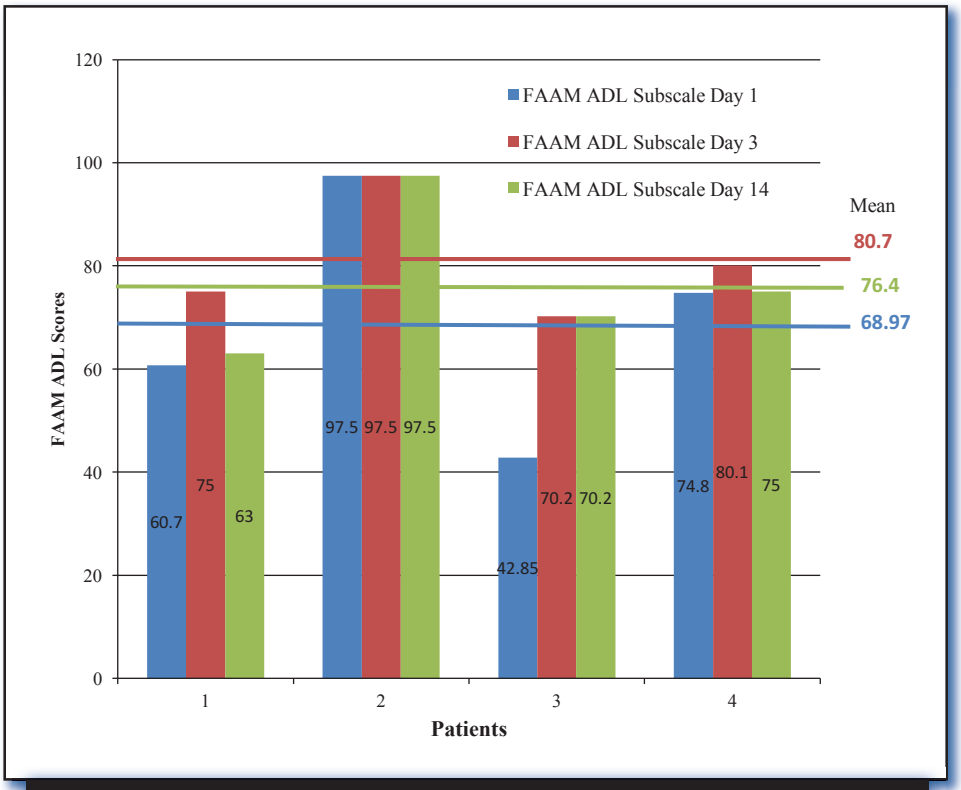

Figure 6. FAAM ADL subscale scores.

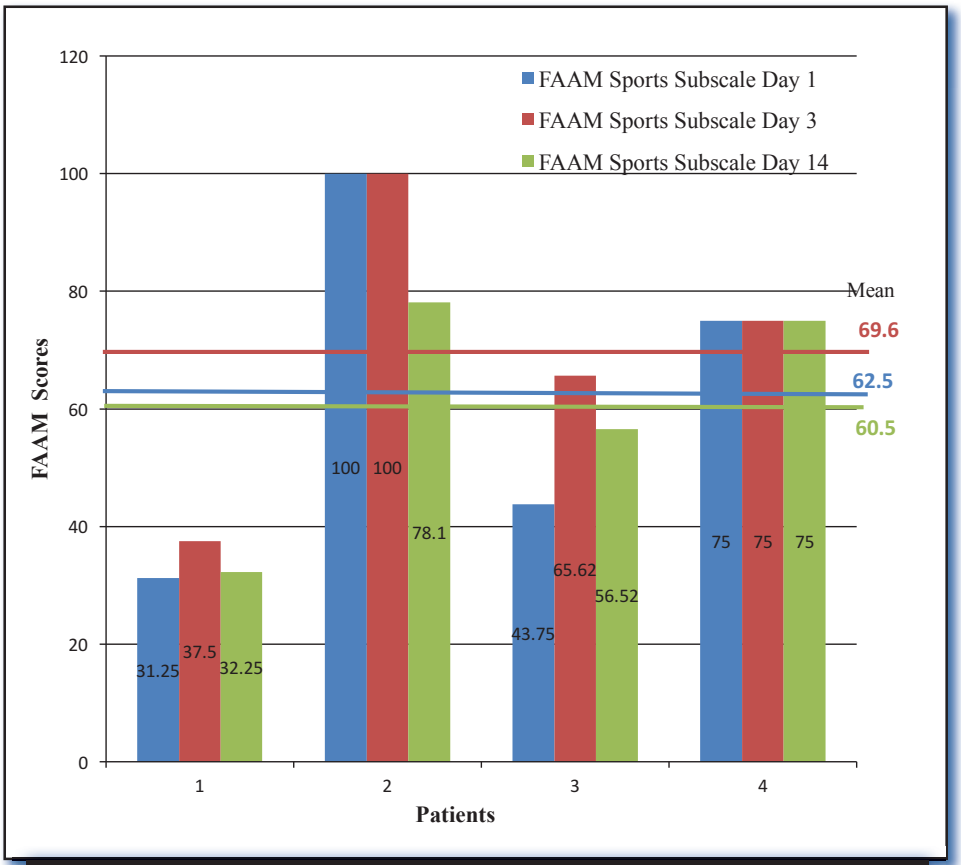

Figure 7. FAAM Sports subscale scores.

DISCUSSION

The purpose of this case series was to evaluate the short-term benefits of Kinesiotaping on pain and function in patients with plantar fasciitis. There is paucity of evidence on short-term benefits of Kinesiotaping on patients with plantar fasciitis. Recent literature has reported improvements in pain and function through application of Kinesiotape to the shoulder and neck.[20,21] The results of this case series are consistent with previous studies that have demonstrated the short term benefits of Kinesiotape on pain and function in patients with musculoskeletal diagnoses. The findings from this case series are also consistent with the 2014 revised version of clinical practice guidelines for foot and ankle pain, which recommend that elastic therapeutic tape should be applied to the gastrocnemius and plantar fascia for short-term (1 week) pain reduction.[8]

The physiological mechanism by which Kinesiotape works on the body remains hypothetical. Some hypothesize Kinesiotape may provide positional stimulus and support to the skin, musculature, and soft tissues to help decrease pain.[22] It is also hypothesized the tape lifts the fascia and soft tissue above the area of the pain assisting in removal of exudates, thereby relieving pain.[22] Some researchers believe the tape serves to enhance proprioception.[23,24] The proprioceptive and kinesthetic input from the tape, as it is applied along the plantar fascia, could potentially encourage patients to practice better body mechanics, and as a result decrease pain and increase function. The tape could give mechanical support to the fascia, which can lessen the impact of the windlass mechanism of the foot, thereby decreasing stress to the plantar fascia. Thelen et al[20] proposed the tape could have also assisted in reducing pain via the gate control theory through stimulation of neuromuscular pathways by increasing afferent feedback.

In this case series, all patients were initially taped on day 1 of the study and had the tape on their skin until at least day 3. According to Kinesiotaping guidelines and the study protocol, the tape would remain on their skin for 3 to 5 days post taping.[13] Patient numbers 3 and 4 had significant improvements in their pain with the first step on day 3, while pain for patient 2 remained unchanged. Patient 3 had complete relief of pain when getting out of bed on day 3. The mean change in NPRS pain scores for initial steps was 3.5 and for out of bed was 2.25, both of which are greater than the MCID for NPRS, which is 2 points.[19] On day 14,

most of the patients did not maintain their NPRS scores of getting out of bed as well as pain with first steps, as compared to day 3. The patients continued with their stretching exercises days 1-14, indicating that reduction in pain on day 3 was a result of tape application on the foot.

The FAAM consists of two subscales, the ADL and Sport subscales.[14] The ADL subscale includes items most common in every day activity such as standing, walking on even ground with and without shoes, climbing stairs, squatting, etc. The Sport subscale consists of items of an active nature such as running, jumping, start and stop, lateral movements, etc. The minimal detectable change (MDC) for FAAM ADL subscale is ± 5.7 points and ± 12.3 points for the Sports subscale.[14] All patients demonstrated improvements of greater than 5.7 points on the ADL subscale of the FAAM on day 3, except patient 2 who demonstrated a ceiling effect with the FAAM ADL subscale. The FAAM ADL subscale scores returned to baseline on day 14 for patient number 1 and 4. Patient 2 demonstrated a ceiling effect on the FAAM ADL scores as described. Patient 3 continued to demonstrate improved function on FAAM ADL subscale, scoring the same on day 14 as day 3. The FAAM Sports scale did not show considerable difference in sports functional scores by day 3 or day 14, except for patient 3. All of the patients in this study were performing activities represented by the ADL subscale on a daily basis. To the researcher's knowledge, none of the patients were actively participating in activities listed on the Sports subscale on a daily basis. This could be the reason for positive detectable changes in the ADL subscale and not on the Sports subscale for these patients. On day 14, the effects of tape did not influence FAAM ADL scores for the majority of patients, indicating that improvement in FAAM ADL on day 3 was a result of tape application on the foot.

In patients with plantar fasciitis, over a period of 3 days, Kinesiotaping was likely the reason for MCID in NPRS scores (≥2 points) and improvements in the FAAM ADL subscale by greater than its MDC (±5.7 points).

All patients were strongly encouraged to continue with stretching of the gastrocnemius and plantar fascia and at least twice a day for the duration of the study to assist in pain relief. The 2014 revised clinical practice guidelines state that there is strong evidence (Grade A on Sackett's scale) that gastrocnemius and plantar fascia stretching may provide short-term relief of pain.[1] The operational definition of "short term" is from 1 week to 4 months.[1] In this case series, 3 to 14 days follow-up may not have been long enough to detect clinically significant changes caused specifically by stretching. Hence, some of the short-term improvements in pain and function may be attributed to the application of Kinesiotape.

Table 3. Summary Table of Means for Pain and Foot and Ankle Measure Scores Across the 3 Days of the Study

Outcome Measures	Day 1	Day 3	Day 14
Pain on Initial Step	6.0	2.5	5.5
Pain 1st Step out Bed	5.25	3.0	5.75
FAAM – ADL Subscale*	68.9	80.7	76.4
FAAM – Sports Subscale*	62.5	69.6	60.5

Abbreviations: FAAM, Foot and Ankle Measure; ADL, Activities of daily living

*Higher scores indicate better function

In 2008, Thelen et al[20] studied the clinical efficacy of Kinesiotape when applied to college students with shoulder pain in which patients had the tape on for two consecutive 3-day intervals. These authors concluded that Kinesiotape may be of some assistance to clinicians in improving pain-free AROM immediately after tape application for patients with shoulder pain.[20] Gonzalez-Iglesias et al[21] in 2009 studied the short term effects of Kinesiotape when applied to the cervical spine on neck pain and cervical ROM in patients with acute whiplash-associated disorders. Data was collected at baseline, immediately after the Kinesiotape application, and at 24-hour follow-up. The authors concluded that the application of Kinesiotape on patients with acute whiplash-associated injury showed statistically significant improvements immediately following application and at 24-hour follow-up.[21] Neither of these studies assessed outcomes more than 1 to 3 days post application, unlike this case series which followed up day 3 and day 14 post application. This study included a follow-up visit on day 14 to determine if the changes in pain and function seen with taping are maintained over a course of 14 days, even if the tape was not on the patient's skin until day 14.

Some limitations of this case series include small sample size, no control group, and lack of long-term follow-up. The researchers recommend future randomized controlled trials with larger sample size studying the long-term effect of taping. It is also recommended that a cross over design would be beneficial to evaluate the effects of taping. Effects of applying Kinesiotape on multiple occasions to cause sustained symptom relief should be studied further. The carry over effect of taping between day 3 and day 14 was not evaluated. It is recommended that further studies be performed to measure how long the effect lasts.

CLINICAL APPLICATIONS

In patients with plantar fasciitis, application of Kinesiotape caused MCID in NPRS scores and improved the FAAM ADL subscale by greater than its MDC over a period of 3 days. Kinesiotaping is effective in the short term to improve pain and increase function in patients with plantar fasciitis.

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Congratulations

Foundation Award Winners

The Foundation recently awarded our 2015 Kendall P. Florence and Research Grants and the following Orthopaedic Section members received a Foundation award:

Christine McDonough
received a Magistro Family Foundation Research Grant, funded by the Magistro Family Foundation Endowment Fund.

Karin Gravare-Silbernagel
received the Pittsburgh-Marquette Challenge Research Grant named in honor of the Marquette Challenge.

Joshua Johnson
received a Kendall Scholarship. This award was funded by the Rhomberger Fund.

Dry Needling in the Management of Pain and Physical Dysfunction—Physical Therapy Scope of Practice Issues

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ABSTRACT

Chronic pain is a common condition that is encountered frequently in physical therapy practice. An often overlooked cause of chronic pain is the presence of myofascial trigger points. The use of fine, filiform needles to manually treat trigger points is called *dry needling*. Recently, dry needling has been added to the scope of physical therapy practice in the United States. Changes to a scope of practice must have a historical basis, must include educational programs that are adequate for training, must provide evidence of clinical effectiveness, and requires a regulatory environment that supports the change. As practice evolves, practitioners must be aware of new treatment techniques and understand the evidence for use in clinical practice. This article will review the background behind adding dry needling into the physical therapy scope of practice and discuss the current status of the treatment.

Key Words: acupuncture, myofascial pain, trigger points, dry needling

INTRODUCTION

Dry needling (DN) has become an increasingly used modality in the treatment of musculoskeletal pain among physical therapists (PTs) in the United States. In 2012, the American Physical Therapy Association (APTA) updated the professional scope of practice to include DN as a skilled intervention in alleviating physical impairment and functional limitations.[1] Accompanying this recent scope of practice change has been a barrage of new research regarding the efficacy and usefulness of dry needling. Postgraduate continuing educational courses to teach physical therapists DN techniques have begun to proliferate in the United States. Dry needling is not a new modality and has been used for decades by physical therapists in other countries. Given the infancy of DN in the American physical therapy community, this discussion aims to review the history of and the issues that surround this new addition to the physical therapy scope of practice.

WHAT IS DRY NEEDLING?

Broadly speaking, DN is a treatment modality that uses thin, solid filament needles to create a therapeutic effect when the skin is punctured. Unlike treatment interventions involving injections to create a clinical effect ("wet needling"), no substance is introduced into the body during DN treatments. Unfortunately, the terminology of the various treatment techniques that can be used with these needles has not been standardized. This has created confusion among the public and health care practitioners (Table 1).

Physical therapists may employ a certain conceptual style of DN or a combination of approaches dependent on education, training, experience, and patient selection. Some DN styles (like the Spinal Segmental Sensitization model) may be outside the scope of PT practice in most locations, as they require injections with anesthetic.[2]

The heterogeneity of needling styles and the variables used in clinical practice challenge anyone evaluating the research involving DN treatments. The vast majority of current research focuses on the deactivation of myofascial trigger points (MTrPs) and this type of DN is the most commonly taught style in postgraduate training programs aimed at PTs. Despite this, it is recommended that the evaluation of clinical practice guidelines for DN be rooted in the best available clinical literature and not a single style or paradigm.[3]

Myofascial trigger points are a common cause of pain and dysfunction. The classic definition of a MTrP is of a "hyperirritable spot, usually in a taut band of skeletal muscle or in the muscle's fascia, that is painful on compression, and can give rise to characteristic referred pain, tenderness and autonomic phenomena."[4] In addition to the tenderness noted on palpation and the frequent presence of a local twitch response when the muscle is palpated cross-fiber, other examination findings are often noted (Table 2).

These examination findings help the clinician differentiate pain and physical dysfunction of MTrP from other conditions such as arthritides, myopathies, and focal inflammatory conditions like tendinitis and bursitis. Myofascial trigger points can develop in any skeletal muscle as a result of injury or overload. The etiology of MTrP development is still under debate with various theoretical scenarios being postulated. The "energy crisis" theory hypothesizes that damaged muscle fibers may shorten as a result of excessive calcium ions being released from the sarcolemma.[5] This prolonged shortening affects the oxygen supply to the muscle with a resultant ischemia, which may account for some of the pain associated with the condition.[6] The muscle shortening that results from MTrPs may occur because of excessive acetylcholine being released from the motor end plate.[7] Gunn proposes a radiculopathy model that suggests that MTrPs develop as a secondary reaction to neuropathic changes.[8]

Interventions for alleviating the pain and dysfunction associated with MTrPs are divided into noninvasive and invasive techniques. Traditionally, PTs have used many of the noninvasive techniques such as stretching, LASER, ultrasound, manual therapy, and transcutaneous electrical nerve stimulation but the efficacy of these interventions is variable.[9] Invasive techniques like DN have gained more interest in the past decade. A review of the mechanisms behind the therapeutic effect of DN on MTrPs is beyond the scope of this paper but is well described in the literature.[10]

HISTORY OF DRY NEEDLING:

The use of DN in treating MTrPs has been documented in the literature as early as the 1940s but was of scant interest in clinical or academic circles for many years.[11] From 1960 – 1975 no academic trials involving trigger point treatments or theory were noted when searching PubMed.[12] The publication of the seminal Travell and Simons's

Table 1. Common Dry Needling Styles

DRY NEEDLING STYLE	DEFINITION/SOURCE
Trigger Point Dry Needling	Myofascial trigger point model.[69]
Intramuscular Manual Therapy	American term associated with the myofascial trigger point model.[1]
Intramuscular Stimulation	Chan Gunn's "radiculopathy model," a neurosegmental model.[70]
Superficial Dry Needling	Baldry Model involves subcutaneous superficial needling.[71]
Spinal Segmental Sensitization Model	Dr. Andrew Fisher: combines features of trigger point model and Gunn's radiculopathy model.[72]
Classical or Traditional Acupuncture	Acupuncture is an ancient form of Chinese medicine involving the insertion of solid filiform needles into the skin at specific point on the body to achieve a therapeutic effect.[73]
Western Medical Acupuncture	A therapeutic modality that is an adaptation of Chinese acupuncture using current knowledge of anatomy, physiology, pathology, and the principles of evidence-based medicine.[74]

Adapted with permission from "The Safe Practice of Dry Needling in Alberta: Summary Report" October 2014.

Table 2. Examination Findings of Myofascial Trigger Points

FEATURES OF MYOFASCIAL PAIN	
SUBJECTIVE FINDINGS:	1. History of spontaneous pain (active trigger points only)
	2. Tenderness and weakness of a muscle
	3. Tendency towards fatigue and insomnia
OBJECTIVE FINDINGS:	1. Palpable, firm band in a skeletal muscle
	2. A local twitch response on cross-fiber palpation of muscle
	3. Decrease range of motion
	4. Weakness without atrophy or neurological deficit
	5. Sustained pressure may cause a predictable pain referral pattern

Myofascial Pain and Dysfunction: The Trigger Point Manuals (Volume 1 and 2) increased interest in the subject of MTrPs but they used, among other treatment modalities, the use of hypodermic needles. The injection of various substances (procaine, saline, corticosteroids) and the use of much larger gauge needles are significantly different compared with current DN techniques.[4]

In the early 1970s, interest in acupuncture for analgesia blossomed in the west with the opening of China to the rest of the world. Gunn from the United States and Lewit of Czechoslovakia published landmark papers in the development of DN for treating myofascial pain in the 1970s and 1980s.[13,14] The first Medline citation of *dry needling* is credited to Lewit's paper that suggested the physical act of needling a MTrP may be a major component of the therapeutic effect and not the result of an injectable substance.

Despite these developments, minimal interest in DN occurred until the turn of the current century. Suddenly a surge of interest developed in the use of DN by many professions including medicine, osteopathy, physical therapy, and chiropractic. The impetus for the interest in DN is multifaceted. A growing evidence base supports the importance of MTrPs as a source of pain and the efficacy of DN in their treatment has helped.[9,15] The high prevalence of and difficulty in treating chronic pain conditions continues to escalate. For example, the use of prescription analgesics by the US population has skyrocketed. From 1996 to 2006, spending on prescription analgesics more than tripled from $4.2 billion to $13.2 billion.[16] The search for nonpharmaceutical interventions for pain was, in part, spurred by the growing abuse of these medications and associated side effects.

SCOPE OF PRACTICE CHANGES IN PHYSICAL THERAPY

The licensing of health care providers and the establishment of a profession's "scope of practice" exist in order to protect public safety, health, and welfare. Regulations exist to guard the public from incompetent and unethical practitioners. Regulations assure a minimum level of competence in providing safe and effective services and provide a means to discipline practitioners who do not uphold a profession's standards. Scope of practice for the physical therapy profession is a dynamic entity and has 3 components: professional, jurisdictional, and personal. The APTA scope of practice guidelines are passed by the House of Delegates and are not related to the *legal* scope of practice. In the United States, physical therapists are licensed in all 50 states and the District of Columbia, Puerto Rico, and the Virgin Islands. The legal or jurisdictional scope of practice is established by each individual state's physical therapy practice act and the regulatory environment varies considerably between states. Individual PTs must practice within the scope of the physical therapy practice defined by their own state's regulatory board.

Modifications to scope of practice acts may occur as a result of education changes, research, technological advances, or changes in health care demands.[17] Scopes of practice of professions are dynamic and evolve over time. According to a collaborative paper published in 2006 involving 6 health care regulatory bodies (medicine, nursing, pharmacy, physical therapy, social work, and occupational therapy), changes in scope of practice are inevitable given the constant evolution of health care and require collaboration between different providers. The unavoidable "overlap" between professions regarding skills and activities is noted. For example, the use of massage is part of the scope of practice of many professions including physical therapy, occupational therapy, nursing, and massage therapy. No one profession can prohibit another from performing a technique they are qualified to perform.

Changes to a scope of practice must have a foundation in 4 critical areas: historical basis, education and training, evidence of benefit to the public, and regulatory environment (Table 3). A discussion of each foundational area in the context of DN in the physical therapy profession follows.

HISTORICAL BASIS FOR CHANGE

The recent inclusion of DN into the APTA scope of practice guidelines is not new when compared to the practice of physical therapy in other countries. Physical therapists in other countries including Canada, Chile, Ireland, Norway, Belgium, Switzerland, the Netherlands, South Africa, Spain, New Zealand, Australia, and the United Kingdom have long used DN as part of their scope of practice.[18] The World Confederation for Physical Therapy is the international organization representing over 350,000 physical therapists in 106 member organizations. In 1991, a subgroup was created called the "International Acupuncture Association of Physical Therapists." The initial core members were from 5 countries where physical therapists had been using DN since the early 1980s and included Australia, South Africa, New Zealand, Sweden, and the United Kingdom. Since then, 6 other countries have joined. In addition to promoting high standards of clinical practice and fostering clinical research, the organization has also published resources including a textbook aimed at physical therapists[19] and an "International Standard of Safe Practice." It is noted that this organization does not focus specifically on the DN of trigger points.

In 2009, the American Academy of Orthopaedic Manual Physical Therapists advocated for the inclusion of DN into the physical therapy scope of practice. The support statement published stated that DN was "a neurophysiological evidence-based treatment technique that requires effective manual assessment of the neuromuscular system." Research has demonstrated that DN is useful with pain control, normalization of motor endplate function, decreasing muscle tension, and accelerating return to active rehabilitation.[20]

The Federation of State Boards of Physical Therapy (FSBPT) has published a number of documents on the topic of DN. In 2010 a resource paper titled, "Intramuscular Manual Therapy (Dry Needling)" delineated definitions of DN, intramuscular manual therapy, and acupuncture. [It is noted that in 2009, the APTA had originally recommended that the term "intramuscular manual therapy" be used to describe the DN technique performed by physical therapists. At present the APTA advises using the more generic term "dry needling" to describe the intervention. The term "intramuscular manual therapy" must not be confused with the CPT code 97140 (Manual Therapy) for insurance billing purposes.] The FSBPT document reviewed the state rulings regarding DN as part of scope of practice and outlined the 4 postgraduate training programs that were available at the time. When the document was published in February 2010, 15 state licensing boards had made specific rulings allowing for DN to be performed.[21]

The FSBPT has updated the resource paper on DN annually in light of the tremendous interest and changes in legislation that have occurred. The 4th edition published in July 2013 contained a review of state rulings with substantial increases in the number of jurisdictions that specifically allowed DN as part of a PT scope of practice being noted. Since then other states have made decisions on the issue of DN. In 2014, Arizona, Delaware, and Utah officially added DN into the scope of practice of PTs working in those states. Of 53 jurisdictions involved, the vast majority allow PTs to perform DN (29 states), have no position or are currently unresolved in the issue. Only 7 states regulatory boards remain that do not allow DN within the scope of practice (California, Idaho, South Dakota, New York, Hawaii, Pennsylvania, Florida).

Physical therapists play a major role in the treatment of MTrPs and the use of trigger point compression techniques are frequently used clinically.[22] Given that musculoskeletal pain and dysfunction is more effectively treated when a multimodal approach is used, DN should be a viable adjunct in the treatment of this condition.

EDUCATION AND TRAINING IN DRY NEEDLING

Historically, DN has not been a component of physical therapy entry-level education in the United States. Exceptions do exist and DN is currently taught at entry-level programs administered at Georgia State University, Mercer University, The University of St. Augustine for Health Sciences, and the Army Physical Therapy program at Baylor. Most physical therapists currently learn DN as a post-graduate skill.[23] In other countries, introductory DN courses aimed at licensed physical therapists are of relatively short duration. Kalichman and Vulfsons concluded that the technique is easy for PTs to safely learn given the education base that is already taught in physical therapy programs.[24]

Following the APTA's investigation of other international physical therapy associations, a summary was published of the status of DN in Australia, Canada, Ireland, and the United Kingdom.[1] In all cases, DN was considered to be a postgraduate intervention and not part of the entry-level programs. Practice guidelines statements from these organizations regarding DN are often reviewed and updated or may be in the draft stage.[25-28]

In February 2013, the APTA published a clinical resource paper regarding DN.[1] It included a description of DN, a review of MTrP physiology and a discussion of the physiological basis for DN treatment. The paper outlined appropriate patient selection for DN with precautionary features and safety concerns. The document stressed that DN is only one component of an intervention plan and rarely used as an isolated modality. The importance of exercise, manual therapy, and education when treating myofascial pain was stressed.

A partial list of continuing education courses in DN was included in the FSBPT Dry Needling Resource Paper updated in July 2013. As a result of the interest in DN, many new companies have developed continuing education (CE) training programs. A list of some currently available courses at the time of this writing can be found in Table 4. There is currently no national standard for DN education and the makeup of these courses varies widely in terms of length of study, cost of training, academic rigor, and syllabus. While some state regulations stipulate the length of study that is considered to be appropriate, length of study does not necessarily correlate with clinical proficiency. Testing competency of either didactic knowledge or practical needling skills is not mandated and varies widely among CE course offerings. Clinicians interested in studying DN may be advised to seek out courses that have been certified by ProCert. ProCert was developed by the FSBPT to evaluate the content of continuing education activities for physical therapists and certify courses that meet their standards of excellence.

Scopes of practice are dynamic entities. What is currently considered to be an advanced or postgraduate skill may change as a result of entry-level education developments or legislation.

Table 3. Four Foundational Areas for Evidence to Support Scope of Practice

FOUNDATIONAL AREA	
HISTORICAL BASIS:	1. Has there been an evolution of the profession towards the addition of the new skill or service? 2. What is the evidence of this evolution? 3. How does the new skill or service fit within or enhance a current area of expertise?
EDUCATION AND TRAINING:	1. Does current entry-level education prepare practitioners to perform this skill as their experience increases? 2. If the change in scope is an advanced skill that would not be tested on the entry-level licensure examination, how is competence in the new technique assured? 3. What are the competence measures available and what is the validity of these measures? 4. Are there training programs within the profession for obtaining the new skill or technique? 5. Are standards and criteria established for these programs? Who develops these standards? How and by whom are these programs evaluated against these standards?
EVIDENCE:	1. Is there evidence within the profession related to the particular procedures and skills involved in the changes in scope? 2. Is there evidence that the procedure or skill is beneficial to public health?
REGULATORY ENVIRONMENT:	1. Is the regulatory board authorized to develop rules related to a changed or expanded scope? 2. Is the board able to determine the assessment mechanisms for determining if an individual professional is competent to perform the task? 3. Does the board have sufficient authority to discipline any practitioner who performs the task or skill incorrectly or might likely harm a patient? 4. Have standards of practice been developed for the new task or skill? 5. How has the education, training and assessment within the profession expanded to include the knowledge base, skill set and judgments required to perform the task and skills? What measure will be in place to assure competence?

EVIDENCE FOR EFFECTIVENESS

The sudden interest in MTrPs and DN treatments may be surprising as the topic is not new. The commonly acceptable diagnosis of MTrPs traditionally relies on manual palpation. Research has shown that the reliability of trigger point identification through manual palpation is poor.[29,30] The intrarater reliability of palpation to locate MTrPs may increase with experience of the practitioner.[31] Without an accurate diagnostic tool or "gold standard" to confirm the presence of MTrPs, evaluating outcomes from intervention with DN can be challenging. The development of sonoelastography and magnetic resonance elastography testing shows promise as tools for imaging of MTrPs but this research is still in its infancy.[32,33]

Despite a lack of a gold standard diagnosing MTrPs, basic research in the pathophysiology of the condition and the efficacy and effectiveness of DN continues to escalate. The pathophysiology of MTrPs is still an area of controversy but recent studies have shown evidence of segmental pain modulation following DN MTrP stimulation.[34,35]

The ongoing need for high quality placebo-controlled trials to determine the effectiveness of DN in the treatment of myofascial trigger points is evident. When evaluating clinical research articles, best levels of evidence can be obtained from high quality diagnostic studies, prospective studies, or randomized controlled trials. Expert opinions, case series, or retrospective studies are less valued according to the Center for Evidence-based Medicine.[36] When reviewing the research dealing with DN in the physical therapy profession, most published articles are from countries outside of the United States. A search on PubMed using the fields "dry needling," "physiotherapy," AND "physical therapy" AND "trigger point" resulted in only 35 articles. Of these papers, only 11 were from US institutions and none were randomized controlled trials. It is not surprising that, given the longer history of DN in physical therapy in other countries, more basic research has been conducted overseas.

In 2012, the APTA analyzed the results of the available systematic reviews and individual research articles dealing with DN.[1] Most of the research available at that time did not make definitive conclusions regarding the efficacy for DN for a variety of conditions over placebo. A systematic review and meta-analysis into the effectiveness of DN in the treatment of myofascial pain of the upper quadrant concluded it was more successful when compared with sham needling or placebo, at least in the short term.[37] Research has concluded that DN shows insufficient evidence for efficacy in treating cervicogenic headaches and other myofascial pain conditions but may be a useful adjunct treatment to conventional physical therapy treatments.[38,39] Tough et al[7]were unable to conclude DN of MTrPs showed a significant effect over placebo but did feel that the overall direction warranted continued on-going large scale, placebo-controlled trials. Since then, many more research articles have been published on the topic of DN in physical therapy practice.[40-42]

REGULATORY ENVIRONMENT/ STATUTORY ISSUES

Challenges to the Physical Therapist Scope of Practice by other professional groups are nothing new. In the latter part of the last century, well-organized campaigns against PTs by the chiropractic lobby to limit the use of manual therapy including spinal manipulation were waged. Challenges to scope of practice were often framed as ethical concerns for public safety instead of the economic motives of the chiropractic establishment for "professional ownership of manipulation."[43] Legal battles resulted in the ability for PTs to be taught and become proficient in manual therapy techniques, including spinal manipulation. Manipula-

Table 4. Current Dry Needling Continuation Courses in the United States (as of July 2015)

Course Sponsor/ Website	Course Titles	Program Length	Cost of Program
Evidence in Motion www.evidenceinmotion.com	A. Level 1 Integrated Trigger Point Needling (lower quarter) B. Level 2 Integrated Trigger Point Needling (upper quarter)	Both level 1 and Level 2 classes can be taken as a 2-day class (an 18 hour lab component + 8 hours on-line) or a 3-day class (27 hours + 8 hours on-line)	2 Day classes: $1,000 3 Day classes: $1,200
Kinetacore Physical Therapy Education www.kinetacore.com	A. Level 1 Functional Dry Needling B. Level 2 Functional Dry Needling C. Functional Therapeutics for Dry Needling D. Dry needling lab: Pelvic Floor	A. Level 1: 3 days (27 hours) B. Level 2: 3 days (27 hours) C. Functional Therapeutics: 3 days (27 hours) D. Pelvic floor lab (4 hours) (NOTE: must have completed first 3 courses and an approved pelvic PT advanced class as a prerequisite for the pelvic floor course)	A: $1,250 B: $1,250 C: $1,100 D: $350
Myopain Seminars www.myopainseminars.com	Program consists of a 3 level dry needling courses: "Foundation course (DN 1 and DN 2) and one "advanced" course (DN 3). NOTE: this new course format began in 2015.	All courses are 28 hours in length	DN 1: $995 DN 2: $995 DN 3: $1095 (includes examination fee)
Therapy Concepts Inc. www.therapyconceptsinc.com	A. Level 1: Trigger Point Dry Needling. B. Level 2: Trigger Point Dry Needling.	A. 3 days (27 hours) B. 3 days (23 hours)	A. $950 B. $950
Spinal Manipulation Institute www.spinalmanipulation.org	A. DN-1: Dry Needling for Craniofacial and upper extremity conditions: an Evidence-based approach. B: DN-2: Dry Needling for Lumbopelvic and Lower Extremity Conditions: an Evidence-based Approach.	A. 3 days (27 hours) B. 3 days (27 hours)	A. $795 B. $795
Double E PT Education www.doubleepteducation.com	A. DN course 1 B. DN course 2	A. 3 days (28 hours) B. 3 days (28 hours)	A. $980 B. $980
Integrative Dry Needling, Orthopaedic Approach www.dryneedlingcourse.com	A. IDN foundations course B. IDN advanced course	A. 3 days (27 hours) B. 3 days (27 hours)	A. $1,295 B. $1,295
Dry Needling Institute LLC www.fishkincenter.com	A. 12-hour course B. 54-hour course	A. 2 days (12 hours) B. 6 days (54 hours)	A. $1,200 B. $3,600
Medbridge Education www.medbridgeeducation.com	A. Functional Dry Needling Part A B. Functional Dry Needling Part B	A. 3.75 hours B. 3.75 hours	A. $100 B. $100

tion is now taught as a part of entry-level physical therapy programs in this country.[44]

Most health care professions will share some skills or procedures with other professions. With the increasing focus on developing health care that is efficient, patient-focused, and based on outcomes, the incongruence of regulatory environments and the needs of the health care industry is evident.[45] It is unreasonable for a profession to have exclusive domain of a skill or activity. For example, physical therapists, massage therapists and nurses all use massage techniques in their professions but none can claim exclusive right to perform massage. A significant lobby by national acupuncture organizations is currently being mounted against PTs performing DN.[46,47]

Despite the shared similarity of tools (in this case, solid filament needles), acupuncture needling by acupuncturists and physical therapy DN are different entities. Historical, theoretical, and practical differences separate the two professions. Any needling treatments that do not involve the use of specific locations normally associated with Traditional Chinese Medicine (TCM) cannot strictly be called acupuncture.[48] As long as physical therapists are not claiming to provide acupuncture treatments, the

	Safety Component	Type of Instruction	Examination/Competency Tests
	Yes	Combined on-line "pre-course" of web-based video and written materials and two days of on-site lab.	Yes (written and "skills assessment")
	Yes	Didactic and practical components	Yes. After classes, students must pass theoretical and practical testing and demonstrate "safety and competency" in order to receive a certificate of completion. Students completing Level 1 must also submit evidence of 200 dry needling treatments logged prior to attending Level 2 training.
	Yes	Didactic and practical lab sessions. Home study (5 hours) is required prior to class.	Each class involves "theoretical and muscle competency" testing.
	Yes	Combined lecture and practical sessions.	Requires treatment logs of 250 or more treatments after Level 1 class to continue with the program.
	Nothing noted in web site syllabus.	Combined didactic and practical sessions.	Written and practical examination required to obtain "certification."
	Yes	Combined didactic and practical sessions.	Written and practical examinations.
	Nothing noted in on-line syllabus.	Didactic and practical lab sessions.	Nothing noted on-line.
	Yes	Didactic and practical lab sessions.	Nothing noted on website.
	Yes	On-line video demonstration only. No practical component.	None

acupuncture establishment has no ability to regulate them.[1]

There are marked differences between MTrP-DN and classic acupuncture in the points treated, the methods of needle insertion, and needle depth. Dry needling for MTrPs targets local myofascial trigger points and not classic acupuncture points. In TCM theory, hundreds of acupuncture points have been described and may be needled to create various therapeutic effects. The World Health Organization has helped standardize the description of 361 classic acupuncture points that are often organized along the 12 primary meridian channels, the 8 extraordinary channels or are described as extraordinary points that are used for empirical reasons.[49] The overlap between locations described for MTrPs and acupuncture points has been known to occur but the frequency of this is in debate.[50,51] The presence of a MTrP is made through palpation and a "fixed" location for these entities cannot be described. The textbook locations used in the descriptions of trigger points (such as are found in the Travell and Simon's books) must only be thought of as a starting guide for a practitioner.

Another category of acupuncture points is described as "ashi" points. Ashi points are tender points in the area that a patient has pain and are found on palpation.[52] These would most closely correspond to MTrPs. It must be noted that simply having pain on palpation is not enough to diagnose an MTrPs.

The "turf war" that is currently being waged between PTs and acupuncturists appears to be mounted in concern for the public good but the main reason may relate to economics. The cost of an acupuncture education in this country (which is usually provided by a "for profit" institution) has increased 3- or 4-fold in the past 15 years. For example, tuition for the Tristate College of Acupuncture for a 3-year M.S. in acupuncture program is now over $70,000. A 2008 survey by the National Certification Commission for Acupuncture and Oriental Medicine (NCCAOM) showed that the average acupuncture student loan debt was over $45,000. A 2013 Job Analysis Survey by the NCCAOM also disclosed that the majority of licensed acupuncturists were independently employed and the median gross income was only $52,000. Over one-third of surveyed acupuncturists reported working "part-time" in the field because of "a lack of patients."[53] It is understandable why acupuncturists are opposed to any competition that they perceive may further limit their income base.

The hours of most introductory DN programs designed for physical therapists are considerably shorter than entry-level acupuncture programs. Licensed physical therapists already possess significant knowledge of anatomy and neurophysiology prior to learning the skill of DN and are well prepared to safely and effectively learn DN techniques. The physical therapy profession has a long history of performing fine wire electromyography (EMG), which involves needle insertion. Once considered an advanced skill, the Commission on Accreditation of Physical Therapy Education currently mandates instruction in electrophysiological testing as part of the entry-level curriculum. Currently 46 states allow PTs to perform needling associated

with EMG and nerve conduction testing.[1]

Many major insurance carriers do not consider trigger point DN to be a billable service at this point in time. Physical therapists must not use the Current Procedural Terminology (CPT) trigger point injection codes (20552 and 20553), the CPT manual therapy code (97140), or the CPT acupuncture codes (97810 and 97811) in the billing for DN procedures. As no specific code exists for DN, the CPT code for "unlisted physical medicine/rehabilitation service" (97799) is recommended.

SAFETY CONCERNS/ADVERSE EFFECTS

One of the arguments against allowing DN into the scope of PT practice relates to safety concerns. As an invasive treatment, trigger point DN has the potential to cause adverse effects (AE). An AE is defined as "any ill effect, no matter how small, that is unintended and non-therapeutic."[54] Adverse side effects from either DN or acupuncture have been well-documented in the literature and are usually mild and transient in nature. These include post-treatment pain, bruising, bleeding, and syncope.[55,56]

When performed by adequately trained practitioners, acupuncture and DN are very safe but there have been documented fatalities and serious side effects as a result of treatment.[57] Needling in the area of the upper trapezius, the thoracic erector spinae, and levator scapulae region are often associated with the increased risk of iatrogenic pneumothorax.[58] The subclavicular and supraclavicular regions, the intercostal and interspinal spaces and abnormal congenital foramen in the area of the sternum, the suprascapular and the interscapular fossae have also been implicated with increased risk. Serious side effects like pneumothorax have occurred but these are very rare and the result of practitioner neglect.[59,60] It is essential that practitioners needling these areas understand the relevant anatomical features when performing DN. Given that MTrPs of the upper trapezius and levator scapulae are two of the most commonly involved in the neck and upper quadrant region, it is essential that practitioners be trained in safe techniques (including correct needle depth and direction) when DN the thorax. The educational programs and professional regulatory agencies must ensure the competency of practitioners who needle these vulnerable areas. In addition, PTs must have a working knowledge of the clinical presentation of a pneumothorax in order to recognize the condition and refer appropriately for medical management in the rare likelihood of it occurring.

Brady et al[61] investigated the incidence of AE among Irish physiotherapists performing MTrP-DN. This prospective study recruited volunteers from 183 physiotherapists who had undergone the 64-hour *David G Simons Academy* MTrP-DN training. Volunteers completed two questionnaires surveying the number of MTrP-DN treatments they had performed and whether any AE had occurred as a result of treatment. Of the 39 physiotherapists who completed the survey, 19.18% reported mild AE associated with the 7,629 treatments that had been performed. Bleeding and bruising was the most common AE but all were deemed to be mild and not significant. No serious AE were reported to have occurred. Compared with studies that looked at AE related to acupuncture, the rate was higher but other studies had looked at AE from a patient's perspective.[62] Patients often underreport AE as a result of a therapy if there is no change or decline in functional status.[63] A major limitation of the Brady paper is that the data was self-reported and practitioners volunteered to participate, which may result in an inaccurate or underreporting of AE.

Anonymous reporting, especially of adverse reactions to intervention, may result in more accurate data. The New Zealand physiotherapy professional organization recently implemented a voluntary system to report adverse effects of PT treatments, including DN and acupuncture. The system is unique in that it also allows for anonymous reporting of AE by physiotherapists and differentiates treatments of MTrP-DN and other styles of needling that involve sustained needle retention (like acupuncture and auriculotherapy).[64] The MTrP-DN accounted for 14.8% of the AE reported compared with over 71% for methods that involved sustained needle retention.

In other countries where physical therapists have been performing DN as part of their scope of practice, most have developed stringent guidelines in order to minimize risks during treatment to ensure public safety. The APTA has developed documents that outline procedures to ensure safety while preforming invasive procedures like DN, EMG testing, and wound care.[1] Compared with the serious side effects that occur as a result of over-the-counter pain and other medications, the mild AE reported as a result of TRP-DN are marginal.[65,66]

All physical therapists in the United States study the Occupational Safety and Health Administration's blood-borne pathogen regulations (standards – 29 CRF), which states "gloves shall be worn when it can be reasonably anticipated that the employee may have hand contact with blood, other potentially infectious materials, mucous membranes and non-intact skin." Specific training in infection control and avoidance of needle stick injuries must be part of the DN training. It is also recommended that therapists have adequate levels of malpractice insurance that will cover procedures that involve skin penetration. The importance of obtaining informed consent from patients prior to deep needling cannot be minimized.

CLINICAL APPLICATIONS

Members of the APTA are bound by a Code of Ethics, which requires members to "provide optimal care to patients and protect the public from unethical acts."[67] If the current physical therapy research shows that DN of MTrPs is an effective treatment modality for a specific group of patients, then this intervention should be available to them.[68] A physical therapist that is appropriately trained and competent to perform DN should be allowed to use the treatment technique if the clinical situation warrants. The recent change in the PT Scope of Practice in the United States has brought the country in line with its international counterparts.

Dry needling appears to be a useful treatment modality when used in a well-designed and executed plan of care. Ongoing research is still needed to help guide a practitioner in the best evidence-based practice. Ultimately, interventions for chronic pain that result in optimal outcomes while containing costs will succeed in the changing health care environment.

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Editor's Note: *Orthopaedic Physical Therapy Practice* encourages paper submissions that reflect the current state of physical therapy practice. As this article states, scope of physical therapy services is ultimately determined by the practice act within the state you hold licensure in. Readers are also encouraged to review the document: "Analysis of Competencies for Dry Needling by Physical Therapists: Final Report," published by the Federation of State Boards of Physical Therapy in collaboration with HumRRO.

http://www.fsbpt.org/FreeResources/RegulatoryResources.aspx

Orthopaedic Section, APTA, Inc.

OCTOBER BOARD OF DIRECTORS MEETING MINUTES

October 15-17, 2015

Stephen McDavitt, President, called a regular meeting of the Board of Directors of the Orthopaedic Section, APTA, Inc. to order at 8:10 AM MDT on Thursday, October 15, 2015.

Present:
Stephen McDavitt, President
Gerard Brennan, Vice President
Kim Wellborn, Treasurer
Aimee Klein, Director
Pam Duffy, Director
Tess Vaughn, Education Chair
Nancy Bloom, Education Vice-Chair
Duane Scott Davis, Research Chair
Kathy Cieslak, Practice Chair
Tara Fredrickson, Executive Associate

Guests:
Chris Hughes, Editor (by phone)

Absent:
Terri DeFlorian, Executive Director

The meeting agenda was approved as printed.

The September 21, 2015, Board of Directors Conference Call Meeting minutes were approved as written.

There were no motions presented on the consent calendar.

The following motions were adopted unanimously via e-mail -

=MOTION 1= On behalf of the Orthopaedic Residency Education Interest Group, Kathy Cieslak, Practice Committee Chair, moved that the Orthopaedic Section Board of Directors sign and send the attached letter (DRP Response letter) to the American Board of Physical Therapy Residency and Fellowship Education (ABPTRFE) to address these issues.

Fiscal Implication: None
ADOPTED (unanimously)

=MOTION 2= Kathy Cieslak, Practice Committee, moved that the Orthopaedic Section Board of Directors approve grant funding for the Iowa Physical Therapy Association (IPTA) chapter to support advocacy efforts on dry needling.

Fiscal implications: $5,000.00
ADOPTED (Stephen McDavitt – in favor; Gerard Brennan – in favor; Kim Wellborn – in favor; Pam Duffy – abstained; Aimee Klein – in favor)

=MOTION 3= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors look into securing Educata for recording some or all of the Orthopaedic programming at CSM 2016 for resale through the Orthopaedic Section web site, Educata's website, and any of Educata's partners (with a revenue share to the Section).

Fiscal Implication: To be determined.

=AMENDMENT TO MOTION 3= Stephen McDavitt, President, moved to amend by striking, 'of the' in the first sentence after, 'for recording some or all'; and striking 'at CSM 2016' after 'Orthopaedic programming'.

Fiscal Implication: None
ADOPTED (unanimously)

=MOTION 3 AMENDED= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors look into securing Educata for recording some or all Orthopaedic programming for resale through the Orthopaedic Section web site, Educata's website, and any of Educata's partners (with a revenue share to the Section).

Fiscal Implication: To be determined.
ADOPTED (unanimously)

=MOTION 4= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors appoint the following work group; Aimee Klein, Chris Hughes, Tara Frederickson, and Nancy Bloom, to investigate the feasibility and outcomes of revenue sharing for recording intellectual property at Orthopaedic Section programming or as determined by the Board of Directors, with a report back to the Board by the December 2015 conference call.

Fiscal Implication: None
ADOPTED (unanimously)

=MOTION 5= Pam Duffy, Director, moved that the Orthopaedic Section Board of Directors nominate Margot Miller, PT, former President of the Occupational Health Special Interest Group, for the APTA Lucy Blair Service Award (posthumous) for 2016. If approved by the Board, Pam will be the lead writer representing the Board for this award and has a team willing to write the other required letters in support. Deadline to submit the nomination to APTA is December 1, 2015.

Fiscal Implications: None
ADOPTED (unanimously)

=MOTION 6= Scott Davis, Research Chair, moved that the Orthopaedic Section Board of Directors approve Amee Seitz PT, PhD, DPT, OCS, as the Vice Chair of the Research
Committee beginning after CSM 2016 with a 3-year term (2016-2019).

Fiscal Implications: None
ADOPTED (unanimously)

=MOTION 7= Pam Duffy, Director, moved that the Orthopaedic Section Board of Directors approve Jared Burch to the Public Relations Committee as the student member for a term of 2015-2017.

ADOPTED (unanimously)

=MOTION 8= Pam Duffy, Director, moved that the Orthopaedic Section Board of Directors approve the Public Relations Policy cover page with an update to the role the Public Relations Committee has in assisting Committees, SIGs and EIGs with social media.

Fiscal Implication: None
ADOPTED as amended with the addition of 'Committees' (unanimous)

Nancy Bloom, Education Co-Chair, updated the Board on the recently held Annual Orthopaedic Meeting (AOM) speaker conference calls. The Board agreed that all breakout session speakers will participate in general sessions to allow for the didactic portion of the presentations to be done prior to the breakout sessions. Tara Fredrickson, Executive Associate, spoke with the Atlanta hotel representatives and the Board agreed to increase break times from 15 to 30 minutes. This will allow time for changing room layouts between general and breakout session sets. Tara also stated that all break out session speakers requested AV.

The Board agreed to the following registration rates for PTs and PTAs for the 2016 AOM:

PT Rates

	Early-bird	Advance	On-site
PT Section Member	595	645	765
PT APTA Member	645	695	800
PT Non-APTA Mbr	845	895	1000

PTA Rates

	Early-bird	Advance	On-site
PTA Section Mbr	360	410	530
PTA APTA Mbr	410	460	565
PTA Non-APTA Mbr	460	510	615

These rates will be evaluated annually by the Board.

The AOM Planning Committee discussed the request from Joe Donnelly, GA Chapter President, to discount GA Chapter Member's registration rate by $50.00. The Section Board of Directors recommended giving a group discount instead of an individual discount.

=MOTION 9= Stephen McDavitt, President, moved that the following group rate be offered for the Annual Orthopaedic Meeting for Section physical therapist members only:

- A minimum of 3 registrations submitted together will constitute a group registration and will be allowed a $50.00 per person discount, therefore making the early-bird rate per registrant $545.00.
- The group discount will only be offered until the cut-off of the early-bird registration deadline.

Fiscal Implication: Less revenue will be collected due to this added discount.
ADOPTED (unanimously)

Tara Fredrickson, Executive Associate, reported that it is too early to request proposals for the 2017 AOM site selection. Due to November being a "peak time" for some of the cities being considered (room rates too high) these locations will be taken out of the running. Tara will continue investigating other cities and will report back to the Board at their December 2015 and January 2016 meeting.

Nancy Bloom, Education Co-Chair, reported on the number of program submissions for CSM 2016. The quality of submissions has continued to improve. The number of submissions can vary depending on the location of CSM. Nancy noted that Orthopaedic Section members are submitting to other Sections where their proposal may be more easily accepted.

Scott Davis, Research Chair, reported on the following –

- 9 Rose Award nominations were received. A recommendation from the Committee will be submitted for Board approval in November.
- 2016 is the final year of the original CRN project. The group is behind, but has increased the rate of recruitment, and it's possible they will request a no-cost extension for another year.
- The Small Grant Program Survey was sent to all individuals who received funding through the Section. Approximately 40% responded. Overall the program has provided value and is meeting the goal of research for our members. Additionally, there has been a very positive response regarding communication with Section leadership and Section Staff.

=MOTION 10= Scott Davis, Research Chair, moved that the Board of Directors appoint Dan White, Scott Davis, Aimee Klein, Debby Givens (Grant Reviewer), Kim Wellborn (ex officio member), Terri DeFlorian, and Lori Michener (CRN) to investigate the future allocation of research funds balanced between the Orthopaedic Section's Small Grant Program and the Foundation for Physical Therapy.
Fiscal Implication: None
ADOPTED (unanimously)

Kathy Cieslak, Practice Chair, reported that an increase in requests for Advocacy Grants related to Dry Needling may occur. Discussion was held regarding the possible need for Practice Committee liaisons for each of the Section's Special Interest Groups.

=MOTION 11= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors approve having Kathy Cieslak, Practice Chair, draft a letter for his signature to APTA's CEO and President, and Jan Reynolds, regarding the continued delays in the release of the 2014 Orthopaedic DSP to all appropriate stakeholders (not just those taking the exam). Letter to be completed within 30 days.
Fiscal Implication: None
ADOPTED (unanimously)

The Board charged Tara Fredrickson, Executive Associate, to create a location on the Section website for posting meeting minutes and linked applicable meeting reports. This will be member-only access and announced in Osteo Blasts. Summarized reports, suitable for the web site, will be sent to Tara from the Education, Practice and Research Committee Chairs within 1 week post-meeting.

Steve McDavitt, President, will create brief pod casts to summarize Board meetings after reviewing submitted reports.

Chris Hughes, *OPTP*/ISC Editor, joined the meeting via conference call and gave the following report-

- Updated the Board on the progress with the technology platform. A soft launch is planned for CSM 2016.
- ISCs are on target to meet or exceed last year's production schedule.
- ISC Advisory Panel is considering new topics for 2018 and will be seeking to replace 2 members. Would also like to bring 2 practicing clinicians onto the panel.
- Based on a survey of ISC registrants, 46% prefer hardcopy of both ISCs and *OPTP*.
- Considering the use of advertising in ISC monographs that are specific to the topic.

Gerard Brennan, Vice President, reported on the following -

- APTA Physical Therapy Outcomes Registry (PTOR) Agreement
  - ✓ Gerard is in communication with Justin Moore at APTA regarding royalties and licenses for the Neck Pain, Shoulder, etc., modules. Justin stated the agreement should be back from the lawyers soon. The new Executive Director for PTOR is Karen Chesborough.
  - ✓ The webinar for the Shoulder Disorders pilot project was held on September 22, 2015. The pilot runs from October 1, 2015 – March 31, 2016.
  - ✓ The Manual of Operations (MOP) for the Knee pilot project is in the process of being finalized. A webinar will be scheduled for late fall 2015 and the pilot will begin after January 1, 2016.
  - ✓ Preparations for the Low Back pilot project have begun and is being led by Julie Fritz. A webinar is planned for early spring 2016.

=MOTION 12= Gerard Brennan, Vice President, moved, that he step-down as Vice Chair of the Physical Therapy Outcomes Registry Task Force due to the development of potential conflicts of interest, effective immediately.

Fiscal Implication: None
ADOPTED (unanimously)

Kim Wellborn, Treasurer, reported on the following –

- A spreadsheet has been created that will assist in calculating reasonable residency site license costs based on average expenses and breakeven points of an ISC. A recommendation on costs will be presented to the Board at CSM 2016.
- The monthly DeFlorian Report has been reformatted and further slight modifications were discussed.
- Net income is down and possible reasons were discussed.
- Financial statements do not currently track the SIG encumbered fund activity. The Treasurer will discuss how to incorporate this detail with the Executive Director.

Tara Fredrickson, Executive Associate, reported for Terri DeFlorian, Executive Director, on the following in her absence.

- Leah continues to assist Tara and Terri with administrative tasks in all areas of their job responsibilities. Plans to hire Leah by the beginning of December or sooner are in place.

=MOTION 13= Stephen McDavitt, President, moved that, for members of the Section who have passed away, the Orthopaedic Section Board of Directors may consider a $250 donation.

Fiscal Implication: None
ADOPTED (unanimous)

=MOTION 14= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors charge the Membership Committee to refine the Member Interest Form to include all Committees, Education Interest Groups (EIG) and all opportunities for involvement, so that this form can be applied appropriately based on the Committee's policies.

Fiscal Implication: None
ADOPTED (unanimously)

=MOTION 15= Pam Duffy, Director, moved that the Orthopaedic Section Board of Directors strike Section II.B. Communication of Membership Value, from the Membership Policies.

Fiscal Implication: None
ADOPTED (unanimously)

=MOTION 16= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors charge the Membership Committee to add another member category specific to Residents and Fellows in the Membership Policies under "III. Recruitment of New Members".

Fiscal Implication: None
ADOPTED (unanimously)

=MOTION 17= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors adopt the Nominating Committee Cover Page and Policies as attached.

Fiscal Implication: None
ADOPTED (unanimously)

=MOTION 18= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors draft a reply to John Ware et al that includes the following concepts: the Section does not have any editorial control over *JOSPT*, the *JOSPT* award is determined by *JOSPT*, and the Orthopaedic Section only provides the platform for the award. The letter will also include that the Board agrees his voice should be heard, and the Board is encouraging him, if desired, to submit his own systematic review to *JOSPT*.

Fiscal Implication: None
ADOPTED (unanimously)

=MOTION 19= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors appoint a Task Force to investigate a name change from 'Orthopaedic Section' to 'Academy of Orthopaedic Physical Therapy' and report back to the Board on their January 2016 conference call. Members will be Aimee Klein (Chair), Stephen McDavitt, Ex-officio member; Pam Duffy, Tom McPoil (past Board member), and Terri DeFlorian.

Fiscal Implication: None
ADOPTED (unanimously)

=MOTION 20= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors adopt the 2015-2019 Orthopaedic Section Strategic Plan as amended.

Fiscal Implication: None
ADOPTED (unanimously)

=MOTION 21= Aimee Klein, Director, moved that the Orthopaedic Section Board of Directors send the Brand and Comprehensive Communication Assessment RFP to a minimum of 5 companies.

Fiscal Implication: None
ADPOTED (unanimously)

=MOTION 22= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors release the PTA Proficiency Task Force report, along with a cover letter that describes the activity and tasks related to PTA Advanced Proficiency working in an orthopaedic setting, to APTA. Stephen will write the letter.

Fiscal Implication: None
ADOPTED (unanimously)

=MOTION 23= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors release the PTA Proficiency Task Force report, along with a cover letter that describes the activity and tasks related to PTA Advanced Proficiency working in an orthopaedic setting, to ACAPT.

Fiscal Implication: None
ADOPTED (unanimously)

=MOTION 24= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors post the PTA Advanced Proficiency Task Force report for member access only on the Orthopaedic Section's website (location to be determined) along with an introduction that will be provided by Stephen McDavitt.

Fiscal Implication: None
ADOPTED (unanimously)
The Board agree to have Stephen McDavitt update the membership in his President's Message in a future issue of *OPTP*.

Stephen McDavitt, President, informed the Board of the North Carolina Federal Anti-Trust Case on dry needling. The North Carolina Acupuncture Licensing Board has been sending Cease and Desist orders against 2 physical therapists who have been performing dry needling. The anti-trust law suit is being brought forward by these physical therapists along with 2 other physical therapists who want to perform dry needling.

=MOTION 25= Kathy Cieslak, Practice Committee Chair, moved that the Orthopaedic Section Board of Directors consider approving an advocacy grant, when submitted by the North Carolina Physical Therapy Association (NCPTA) to support advocacy and legal efforts on dry needling. In addition, the Section will provide further support by placing a banner on the Section web site and include in an Osteo Blast.

Fiscal implications: None
ADOPTED (unanimously)

All Committee and SIG reports submitted will be posted to the Section web site. Below are the updates that were given at this meeting:

Pam Duffy, Director, reported that the Public Relations Committee, OHSIG, Practice Committee, Residency and Fellowship EIG are on track with their initiatives and there is nothing new to report. There has been no communication with the PMSIG. Pam will contact the SIG President.

Aimee Klein, Director, reported that the PASIG, Research Committee and Manual Therapy EIG are on track with their initiatives and there is nothing new to report. There has been no communication with the FASIG.

Kim Wellborn, Treasurer, reported that the Membership Committee is on track with their initiatives and there is nothing new to report.

Gerard Brennan, Vice President, reported that the ARSIG course that was to be offered in Georgia was cancelled due to low registration numbers.

Stephen McDavitt, President, reported that the Imaging SIG is working on a position statement for the House of Delegates related to the scope of practice in imaging. A strategic planning meeting will be held on Tuesday prior to CSM 2016. Janet Bezner will facilitate.

=MOTION 26= Stephen McDavitt, President, moved that the 2016 Orthopaedic Section budget be approved, to include utilizing $91,415.00 from the Wells Fargo Advisors Practice, Education, and Research Endowment Fund in order to create a balanced budget.
Fiscal Implication: None
ADOPTED (unanimously)

=MOTION 27= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors charge the Section Treasurer and staff to develop talking points that summarize 2016 budgetary decisions to aid in answering anticipated questions that may be raised by the membership.
Fiscal Implication: None
ADOPTED (unanimously)

=MOTION 28= Stephen McDavitt, President, moved that the Finance Committee and staff provide a progress report as part of the monthly Finance Committee report to the Board regarding the investigation into updating the accounting software to aid in reformatting the budget. The updated budget will include detailed grant tracking and encumbered fund detail for SIGs.
Fiscal Implication: None
ADOPTED (unanimously)

Tara Fredrickson, Executive Associate, gave the following office update for Terri DeFlorian, Executive Director:

- HVAC
  - ✓ Building is complete.
  - ✓ All work is on scheduled to be completed by mid-October.
  - ✓ The project is expected to be completed within budget.
  - ✓ The Board had no questions on the financial accounting presented.

Tara Fredrickson, Executive Associate, reported on the status of the website redesign and template pages. The Board was shown the latest examples. Tara will share these template pages with the Public Relations Chair for his feedback. The Board gave approval for Web Team to begin building the home page, and template pages once feedback has been obtained from the Public Relations Committee. Tara will also ask the Committees and SIGs for their feedback on populating their individual pages. Following is a list of what will be included on all pages:

- Officer director
- "Join us" feature
- Minutes
- Links of interest
- Member directory
- Link to your private FB page (Pam will discuss this)
- Policies/policy P&P

Aimee Klein, Director, requested that the CSM Board meeting on Wednesday not conflict with the Specialist Certification Ceremony. This will be further discussed on the President, Vice President, and Executive Director weekly call. No change will be made for 2016.

Following are the upcoming Board of Directors Meetings:

- November 9, 2015 – Board Conference Call
- December 14, 2015 – Board Conference Call
- January 11, 2016 – Board Conference Call
- February 17-20, 2016 – CSM Anaheim, CA

Stephen McDavitt, President, asked for any closing comments. There were none so the meeting was adjourned.

ADJOURNED 12:00 PM Noon MST

Book Reviews

Michael J. Wooden, PT, MS, OCS
Book Review Editor

Book reviews are coordinated in collaboration with Doody Enterprises, Inc.

A Clinician's Guide to Balance and Dizziness: Evaluation and Treatment, Slack Incorporated, 2015, $68.95
ISBN: 9781617110603, 372 pages, Soft Cover

Author: Plishka, Charles M., PT, DPT

Description: This book covers the evaluation and treatment of diagnoses affecting the balance systems, including vestibular, vision (oculomotor), and musculoskeletal and somatosensory. **Purpose:** The purpose is to detail the basics of evaluation and intervention strategies for patients complaining of decreased functional mobility, disequilibrium, and/or dizziness. The book introduces the balance system and provides sufficient anatomical, physiological, and clinical information to perform a thorough evaluation of these patients. The objective is important in light of the growing segment of the population aged 65 or older. As this population grows, the need to have clinicians skilled in the assessment of balance, dizziness, and functional mobility becomes more pressing. The author successfully meets the objective, clearly describing the different evaluations and interventions used to address balance dysfunction. The book is very descriptive with good images, while the accompanying website offers videos. **Audience:** It is specifically written for clinicians. Dr. Plishka is a clinician in a private practice balance clinic who offers continuing education courses and consults and assists with program development in the area of balance and disequilibrium. He also contributes time to the American Physical Therapy Association vestibular special interest group and the mentoring subcommittee of the neurology section. **Features:** This book covers the mechanics of performing an examination in creating a plan of care for patients with balance issues and/or dizziness. Chapters focus on vestibular examination and intervention, benign paroxysmal positional vertigo (BPPV), vision system, musculoskeletal and somatosensory systems, and central processing, memory, and cognition. The book leads readers through a logical sequence for performing various examinations and interventions. It also touches on medications, balance interventions, examples of documentation, ending with various case examples. The book is exemplary in the description of the evaluation and interventions for people with vestibular problems. Among the highlights are photographs and videos that illustrate a vestibular examination and intervention. It spends less time on interventions for people who have musculoskeletal or somatosensory problems, and provides little information about people who may have had a concussion that led to balance or dizziness disorders. **Assessment:** This is an excellent resource for clinicians who evaluate and treat people with balance and dizziness. The strength of the text lies in its coverage of problems related to the vestibular system, BPPV, and oculomotor system. The videos on the accompanying website and the photographs in the book of the examinations and interventions give this book the advantage over other, similar books.

Daryl Lawson, PT, DSc
Elon University

Recognizing and Reporting Red Flags for the Physical Therapist Assistant, Elsevier, 2015, $69.95
ISBN: 9781455745388, 233 pages, Soft Cover

Author: Goodman, Catherine Cavallaro, MBA, PT, CBP; Marshall, Charlene, BS, PTA

Description: This easy-to-read reference provides physical therapist assistants (PTAs) with useful tools to detect patient situations that require a physical therapist's (PT) attention and possible reevaluation. Each chapter includes realistic case examples, boxes with quick snapshots of clinical presentations and guidance, and a relevant section titled PTA Action Plan, which guides the PTA/PTA student toward the next appropriate step and documentation required in specific clinical situations. **Purpose:** The purpose is to provide a resource for PTAs and PTA students to help them recognize situations that may warrant further evaluation either by a PT or another healthcare professional. These are certainly worthy objectives in the current healthcare climate, where patients either bypass physicians altogether when being evaluated by a PT, or get only minimal time with their physician during an office visit. The authors effectively meet their objectives in this well-organized, comprehensive book. The approach steers the PTA's mindset to consider systemic, visceral, and/or other sources of patients' symptoms. **Audience:** While this book is intended for PTAs and PTA students, it also can serve as an effective refresher and quick reference guide for PTs. It provides accurate tips on care to help PTAs initiate and engage in effective communication with a PT when further evaluation may be necessary. It also provides valuable information about appropriate documentation. **Features:** This is a comprehensive, well-organized book with the primary purpose of enabling PTAs to recognize inconsistent pain patterns, referred pain, and yellow and red flags. It also is effective in helping PTAs determine what is and is not within the scope of their ability, and what requires additional, further evaluation by a PT. The book is divided by body regions, which makes it a practical guide and enables PTAs to use it as a quick reference while in the clinic. The photographs and illustrations are well done and enhance the quality of the text. Case studies in each chapter enable PTAs to exercise critical thinking. **Assessment:** Each chapter includes useful reference tables with lists of symptoms, clinical presentations and pathologies, risk factors, and guidelines. This is the first book that provides PTAs with pivotal information to help them recognize a patient's need for further PT evaluation.

Sunita Mani, PT, DPT, MBA
University Medical Center of Princeton at Plainsboro

Physical Therapy Examination and Assessment, Thieme Medical Publishers, Inc., 2015, $59.99
ISBN: 9783131746412, 230 pages, Soft Cover

Editor: Hueter-Becker, Antje; Doelken, Mechthild

Description: This book outlines the evaluation and examination of patients by physical therapists and includes free online access to patient assessment forms. Originally written for a German audience, it was recently translated into English. **Purpose:** The purpose is to assist physical therapy students in developing the evaluation techniques and examination procedures necessary to create a physical therapy diagnosis and a plan of care. **Audience:** Physical therapy students are the intended audience for this book. The authors are both instructors in physical therapy educational programs in Germany. **Features:** Initial chapters discuss the importance of the examination and evaluation of the patient. A retrospective assessment is included to assist novice clinicians gain insight and help them become expert clinicians. The general assessment, including range of motion, muscle and neural tissue, posture, and muscle balance, is covered. The inclusion of the calculation of body mass index and the use of skin calipers is unique. Examination of patients who present with pain as their main complaint is detailed in a separate chapter. Another chapter focuses on cardiopulmonary function evaluation. Evaluations such as blood pressure measurement, examination of nails, etc., and other measures that can be done in an office are reviewed. The photographs throughout the book are high quality and demonstrate the examination techniques well. Case studies are presented throughout to illustrate key points. **Assessment:** Although this book is written for physical therapy students, it would appeal more to this audience if the chapters were organized by body part. This would allow for more detail about special tests for specific pathologies and evaluation procedures. However, the book does a good job of describing and illustrating the various neural tests and some provocation tests.

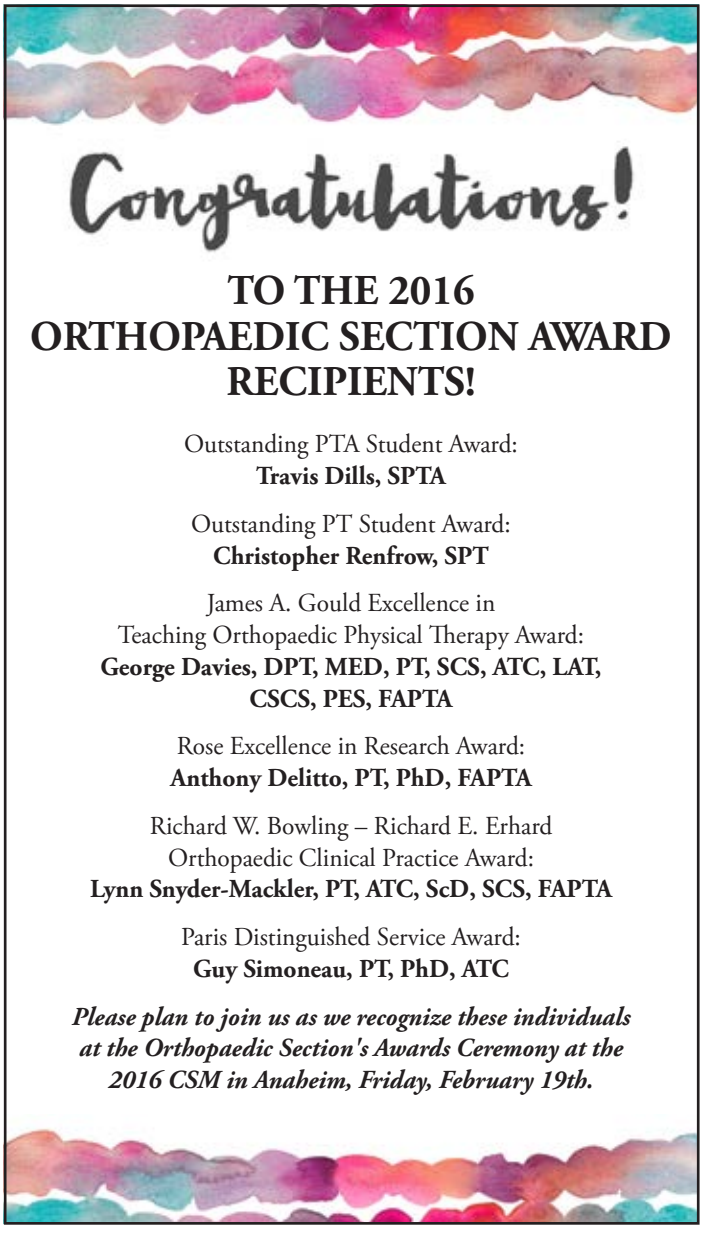
Jeff Yaver, PT
Kaiser Permanente

A Manual of Orthopaedic Terminology, 8th Edition, Elsevier, 2015, $69.95
ISBN: 9780323221580, 505 pages, Soft Cover

Editor: Nelson, Fred R. T., MD, FAAOS; Blauvelt, Carolyn Taliaferro

Description: This is a straightforward, easy-to-search comprehensive resource of orthopedic terminology. Currently in its eighth edition, it was first published 35 years ago and is updated about every five years or so, driven by advances in the field. **Purpose:** As the field of orthopedics has evolved, so have all of the associated allied health fields, and with it, its terminology. The purpose is to provide a comprehensive reference for use by all in these areas. There are many encyclopedic medical dictionaries that service the entire spectrum of medicine and science, but this one specializes in the language of orthopedics in comprehensive depth. **Audience:** This is designed to be of particular value to orthopedic interns, residents, nurses/technicians, medical office managers, medical transcriptionists, medical coders, and attorneys. Additionally, professionals involved in radiology/imaging, prosthetics, orthotics, and physical and occupational therapy will find this a practical reference. Students in all these fields also will find this useful during their studies. The authors developed the overall concept for this book and acknowledge the 23 contributors from many of the best hospitals and research facilities in the U.S. who assisted in this update. **Features:** The book covers terminology related to general anatomy, surgery, fractures, dislocations, laboratory, evaluations, prosthetics, orthotics, rehabilitation, imaging, and regional anatomy specific to orthopedics. The organization by topic makes it very easy to find terms, even when readers aren't sure how a term may be spelled. Appendix C serves as a primer on etymology or the original meanings of words, which will assist readers in understanding this specialty. Tables, figures, and diagrams are in black and white. This edition includes significant online content. **Assessment:** This is an excellent resource with timely relevance to the continuously evolving field of orthopedic medicine. It is unique as a reference dedicated solely to the terminology of orthopedics. I would have used this all the time when I was a physical therapy student. Now, as a seasoned practitioner, I will make room for this on my clinic bookshelf.

Charles R. Wolfe III, PT, DPT, DAC
U.S. HealthWorks Medical Group, Inc.



Alternative Special Topics:

Innovations in Practice

An Independent Study Course Designed for Individual Continuing Education

Independent Study Course 25.3

Course Description

This unique series of monographs contains updated and timely topics on areas of practice influenced by changes in health care and new technologies. The topics will assist clinicians in staying up-to-date to meet the ever-changing demands of practice. Topics include management of shoulder instability, update on treatment of ACL injuries, patellofemoral pain, osteoporosis, management strategies for the obese patient, and musculoskeletal ultrasound.

Topics and Authors

- **The Unstable Shoulder** Brittany Lynch, PT, DPT; Tara Ridge, MS, PT, SCS; Dharmesh Vyas, MD, PhD
- **Advances in Anterior Cruciate Ligament Surgery & Rehabilitation** Kristi Campanella, PT, DPT, OCS, MEd, CPI
- **Patellofemoral Pain & Rehabilitation** Cory Manton, PT, DPT, OCS, CSCS
- **Evaluation and Treatment of the Patient with Osteoporosis** Cynthia Watson, PT, DPT
- **Orthopaedic Management of the Obese Patient** Christopher Lavallee, PT, DPT
- **Musculoskeletal Ultrasound: Its Use in Evaluation and Treatment** Amber Donaldson, DPT, M Physio (Manip), SCS, CSCS; Dustin Nabhan, DC, DAC, BSP, CSCS

3-bundle set includes the following 3 topics: The Unstable Shoulder, Advances in ACL Ligament Surgery & Rehabilitation, and Patellofemoral Pain & Rehabilitation. **6-bundle set** includes all of the bulleted topics listed above.

Continuing Education Credit

Fifteen contact hours for the 3-bundle set and **30 contact hours** for the 6-bundle set will be awarded to registrants who successfully complete the final examination. The Orthopaedic Section pursues CEU approval from the following states: Nevada, Ohio, Oklahoma, California, and Texas. Registrants from other states must apply to their individual State Licensure Boards for approval of continuing education credit.

Course content is not intended for use by participants outside the scope of their license or regulation.

Editorial Staff

Christopher Hughes, PT, PhD, OCS, CSCS—Editor
Gordon Riddle, PT, DPT, ATC, OCS, SCS, CSCS—Associate Editor
Sharon Klinski—Managing Editor

Learning Objectives

Upon completion of this course, the participant will be able to do the following:

3-monograph bundle

- Define glenohumeral instability and laxity and describe incidence, prevalence, pathomechanics, and mechanism of injury for each.
- Describe the active and passive restraints about the shoulder and describe classification systems for shoulder instability.
- Determine the role of diagnostic testing.
- Determine and perform an examination using appropriate tests and measures to accurately assess shoulder instability and the associated impairments and functional limitations.
- Identify patients most appropriate for nonoperative management of shoulder instability and implement an evidence-based rehabilitation program.
- Understand anatomy and biomechanics of the anterior cruciate ligament and common mechanisms of injury.
- Describe the evidence governing clinical and imaging tests for diagnosing anterior cruciate ligament tears.
- Understand current surgical procedures for various populations and how they impact rehabilitation and recovery.
- Understand the rationale for anterior cruciate ligament prevention programs.
- Identify predictors of anterior cruciate ligament tears and proper testing for risk assessment as supported by research.
- Discuss the biomechanics and pathomechanics of the patellofemoral region and identify movement patterns that may contribute to patellofemoral pain.
- Discuss physical therapy classification of patients with patellofemoral pain.
- Provide evidence-based review of functional tests for the lower extremity.
- Identify and discuss tests and measures that can be used in the identification of pain generators of the patellofemoral region.
- Review current surgical interventions for treatment of patellofemoral pain.

6-monograph bundle

Includes the learning objectives listed above and the following:

- List the risk factors associated with osteoporosis and how such risks are measured.
- Recognize the most common risk factors associated with falls in the elderly.
- Identify self-report measures and clinical tests used to ascertain fall risk and strength.
- Discuss strategies that may be used to reduce fall risk in this population.
- Prescribe and adjust an appropriate exercise program for the patient with osteoporosis.
- Discuss the etiology and prevalence of obesity and list disease risks associated with increasing body mass index as supported by research.
- Identify the genetic, cultural, educational, and age-related characteristics that influence the plan of care for the patient with obesity.
- Review evidence related to the association between increasing weight and painful conditions (ie, low back pain, osteoarthritis) and how they decrease quality of life.
- Explain the evidence-based modifications that should be made when treating patients who are obese.
- Understand the imaging principles of musculoskeletal ultrasound.
- Be familiar with basic scanning methods and normal sonographic anatomy.
- Understand the clinical indications for musculoskeletal and therapeutic ultrasound interventions in orthopaedic physical therapy.
- Be familiar with the appearance of select pathologies using ultrasound.
- Be familiar with invasive and noninvasive ultrasound-guided therapies.

For Registration and Fees, visit orthopt.org
Additional Questions—Call toll free 800/444-3982

OCCUPATIONAL HEALTH

SPECIAL INTEREST GROUP

President's Message

Lorena Pettet Payne, PT, MPA, OCS

Pre-conference Program - Tuesday, February 16, 2016, 8:00 a.m. - 5:00 p.m.
Diversifying and Increasing Your Revenue Stream-Develop the Occupational Health Component of Your Practice
Presenters: John Lowe, PT; Herb Doerr, PT

CANCELLED

If you are interested in offering more services to industry and workers, plan to sign up for the pre-conference course. Take advantage of this highly interactive session to develop your plan to partner with industry, growing and diversifying your practice. Two seasoned occupational health professionals will personally assist you in the development of a specific, detailed plan to immediately apply to your practice. Get the answers you need to successfully add or improve your occupational health services.

Regular Programming: Thursday, February 18, 2016, 8:00 a.m. - 10:00 a.m.
From Hire to Retire - Make Work Place Injury Prevention and Wellness Part of your Practice
Presenters: Douglas P. Flint, DPT, OCS; Phil Jiricko, MD, MHA

Overview of pre-employment and post-offer screening, injury prevention services, assessing and monitoring the health and function of employees through their entire employment, statistics from work with firefighters and other public service sectors will be reviewed as an example that can be applied to your practice, sub-maximal testing for VO2 MAX, and MET and the role it plays in identification of health and injury risk, diet, and exercise guidelines for workers with high risk factors for injury and illness

Between the publishing dates of *Orthopaedic Physical Therapy Practice*, common themes tend to emerge out of my interactions with patients, clients, and colleagues. During this last stretch as always, several themes forced me to reflect, taking a pause to assess my own practice. First, passage of family, friends, and colleagues leaves a deafening silence. Margot Miller was a strong influence on many as a teacher with years of experience related to prevention of work injury. She had keen insight regarding the role of the Physical Therapist in occupational health. Always willing to share some insight, I called upon her for advice many times. In honor of Margot, I will reflect upon my own enthusiasm and dedication to the profession and especially the role of physical therapists in prevention and management of work related illness and injury. Our thoughts go out to her family, friends, and colleagues.

A second theme involves lessons learned when offering pre-placement or return-to-work screens. I have been reminded that routine reassessment of each job is necessary to verify content validity of the screen. When a relationship is discontinued, make it understood that the screening process is no longer valid without your involvement in the implementation or revalidation of the screen. That being said, physical therapists do not have ultimate power in this process, however, we need to do all that we can to assist employers and employees remain safe and compliant. **See you at the OHSIG Membership Meeting - Thursday, February 18, 2016, from 7:00 a.m. -8:00 a.m. at the Combined Sections Meeting!**

Using Caution When Interpreting MRI Reports for Worker's Compensation Patients with Low Back Pain

Katie McBee, PT, DPT, OCS, MS, CEASII
David Hoyle, PT, DPT, MA, OCS, MTC, CEAS

The prevalence of disability from low back pain is on the rise.[1] Low back pain is the single leading cause of disability worldwide.[2] The use of imaging, opioid analgesic prescriptions, lumbosacral injections, and lumbar fusions is also on the rise.[3] Is this a coincidence? Perhaps it is not. Review of available literature identifies psychosocial factors related to poor outcomes and disability from episodes of low back pain including fear avoidance beliefs/kinesiophobia, depression, pain catastrophizing, perceived injustice, and poor self-efficacy.[4-9] Correlation with biomechanical factors like disk disease severity, spondylolisthesis, and spondylosis do not demonstrate as much power as the previously listed psychosocial factors at predicting poor outcomes and longer term disability.[10-14] Only about 10% of low back pain cases can be given a definitive anatomic cause. The remainder of cases fall under the diagnosis of "nonspecific low back pain" due to a lack of clear correlation to a structure.[15-17]

Performance of MRIs in the management of low back pain have been linked to worse health outcomes, increased likelihood of disability, and longer disability duration.[18] Workers who present with low back pain that have an early MRI, in the absence of key indicators for significant pathology, have a higher risk of disability and surgery, irrespective of the severity of the MRI findings.[19] Webster and Cifuentes found surgery rates of those who did not get an early MRI when it was not indicated had a 10% rate of surgery and those who did get an early MRI without indications of serious pathology had a 100% rate of spinal surgery.[19] Studies in worker's compensation patients have found that surgery for this population does not support lumbar fusion or disk replacement surgery as a means to achieving return-to-work or relief of pain unless strict criteria are met.[20] Workers with low back injury who receive lumbar fusion for disk degeneration, disk herniation, and or radiculopathy are associated with an increase in disability, increased opiate use, prolonged work loss, and poor return-to-work outcomes.[21] Increased opioid use for worker's compensation patients with low back pain has been shown to increase disability at 6 months and fails

to show improvement in functional outcomes or return-to-work rates for acute low back pain.[22]

Studies investigating MRI results of individuals without back pain have found significant anatomic changes including 91% having disk degeneration, 56% having loss of disk height, 64% having disk bulges, 32% having disk protrusions, and 38% having annular tears.[23] Several studies have shown that prevalence of abnormalities on an MRI do not correlate with reports of low back pain, the severity of pain, or the prediction of chronicity.[11-14,16] Magnetic resonance imaging has not been shown to be able to predict people who will develop future back pain over a 7-year period.[15] Despite massive disk herniation found on MRI, a good prognosis for recovery has been shown with conservative management as long as early progress is seen. Serial MRI scans have demonstrated significant reduction in disk protrusion, and despite ongoing disk protrusion, significant gains in clinical improvement or complete resolution of symptoms have been shown.

In order to achieve more pain relief, more function and improved return-to-work outcomes for injured workers with low back pain covered under the worker's compensation system, it is critical that the ordering of MRIs be based on strict guidelines. The education of patients on subsequent findings needs to be presented in a manner that is easily understood and does not induce fear or hopelessness. One review of 17 studies in 8 countries found that health care practitioners, including physiotherapists, who had biomedical orientation or elevated fear avoidance beliefs towards low back pain were more likely to advise patients to limit work and physical activities and less likely to adhere to treatment guidelines.[6] Another study found that physiotherapists only partially recognize psychosocial risk factors and are much more comfortable dealing with the mechanical aspects of low back pain. Some therapists stigmatize the behaviors suggestive of psychosocial factors that are thought to contribute to low back pain and disability.[24] It is important that physical therapists are mindful of personal beliefs and the impact that they can have on our patients and their recovery and outcomes. When it comes to low back pain and discussing the need for MRI, it is important to follow guidelines to reduce exposure that can lead iatrogenic harm.

Because health care practitioner bias can affect patients' beliefs, bias, and recovery, it is critical that clinicians understand that red flags are present in only a small percentage of patients with low back pain. About 4% have a compression fracture, 3% spondylolisthesis, 0.7% a tumor or metastasis, 0.3% ankylosing spondylitis, and 0.01% an infection.[17] Table 1 reviews red flags and basic screening procedures.

Based on the review of 16 low back pain management guidelines that meet established criteria and were published between 2001 and 2011, Ladeira recommends triaging individuals with low back pain into one of 3 categories: (1) patients likely to have serious pathologies, (2) patients with LBP and radiculopathy, or (3) patients with nonspecific LBP.[25]

This triage approach was consistent in 11 guidelines and looks to identify patients who can be treated conservatively without the need for referral to a specialist, without additional diagnostic imaging, and without invasive procedures. The triage approach is based on the identification of red and yellow flags based on patient signs and symptoms identified during the history and physical examination. Red flags (Table 1) are associated with serious spinal pathology. Yellow flags (Table 2) may indicate a need for behavioral based interventions.

An MRI is rarely indicated in the first 6 weeks of onset of low back pain. Exceptions are listed in guidelines published by the American College of Occupational and Environmental Medicine (ACOEM) and include the demonstration of progressive neurologic deficit, cauda equina syndrome, significant trauma with no improvement in atypical symptoms, a history of neoplasia (cancer), or atypical presentation (eg, clinical picture suggests multiple nerve root involvement). The ACOEM does not recommend MRI for patients with radiculopathy unless, at 4 to 6 weeks, symptoms are "severe and not trending towards improvement and both the patient and the surgeon are willing to consider prompt surgical treatment, assuming the MRI confirms ongoing nerve root compression." Following 4 to 6 weeks from onset, ACOEM recommends MRI for subacute or chronic radicular pain syndromes when the symptoms are not trending towards improvement if both the patient and surgeon are considering prompt surgical treatment, assuming the MRI confirms ongoing nerve root compression. In cases where an epidural glucocorticosteroid injection is being considered for temporary relief of acute or subacute radiculopathy, MRI at 3 to 4 weeks (before the epidural steroid injection) may be reasonable. In cases where conservative treatment (including NSAIDs, aerobic exercise, other exercise, and considerations for manipulation and acupuncture) over the course of 3 months have failed, MRI is recommended as an option for the evaluation of select chronic LBP patients in order to rule out concurrent pathology unrelated to the injury.[26]

When MRIs are indicated, it is important that results are communicated to patients using language that is easy to interpret and will not induce fear. Many existing medical terms included in MRI reports have been shown to have different meanings to patients than intended and should be used with caution.[10] Some examples of these terms include patients interpreting "wear and tear" as a "loss of structural integrity," "deterioration" as their spine is "crumbling" and "collapsing," "non-specific = "non-existent," "instability" = "liable to pop out."[27] The use of these terms by patients is associated with a poorly perceived prognosis. These terms are used more frequently by patients when they were documented in notes or reports provided by health care providers. The explanation of MRI findings to a patient using language that does not induce fear like "the spine is strong" or "these findings are normal and are not correlated with pain" among other true but calming language is a great opportunity to change a patient's prognosis and improve outcomes instead of enforcing or creating psychosocial risk factors. It has been shown that strategies to decrease psychosocial risk factors can increase return-to-work outcomes.[28] One study demonstrated value in the inclusion of the following statement on MRI results, "The following findings are so common in people without low back pain that while we report their presence they must be interpreted with caution and in context of the clinical situation." This simple statement included by radiologist on the MRI report was associated with decreased prescriptions of narcotic medications from primary care physicians.[23]

The impact of MRI results and the method in which they are communicated to patients can greatly impact outcomes. Clinicians should use caution when interpreting results with patients and be sure to use language that does not increase fear. When

Table 1.

Red Flags	History and Physical Exam	Sensitivity	Specificity
Back-related Tumor	Constant pain not affected by position or activity; worse with weight bearing, worse at night	–	–
	Age over 50	0.84	0.69
	History of cancer	0.55	0.98
	Failure of conservative intervention	0.29	0.90
	Unexplained weight loss	0.15	0.94
	No relief with bedrest	1.00	0.46
Cauda Equina Syndrome	Urine retention	0.90	0.95
	Fecal incontinence	–	–
	Saddle anesthesia	0.75	–
	Sensory or motor deficits in the feet (L4, L5, S1 areas)	0.80	–
Back-related Infection	Recent infection (eg, urinary tract or skin), intravenous drug user/abuser	0.40	–
	Concurrent immunosuppressive disorder	–	–
	Deep constant pain, increases with weight bearing	–	–
	Fever, malaise, and swelling	–	–
	Spine rigidity; accessory mobility may be limited	–	–
	Fever: tuberculosis osteomyelitis	0.27	0.98
	Fever: pyogenic osteomyelitis	0.50	0.98
	Fever: spinal epidural abscess	0.83	0.90
Spinal Compression Fracture	History of major trauma such as vehicular accident, fall from a height, or direct blow to the spine	0.30	0.85
	Age over 50	0.79	0.64
	Age over 75	0.59	0.84
	Prolonged use of corticosteroids	–	–
	Point tenderness over site of fracture	–	–
	Increased pain with weight bearing	–	–
Abdominal Aneurysm (> 4 cm)	Back, abdominal, or groin pain	–	–
	Presence of peripheral vascular disease or coronary artery disease and associated risk factors (age over 50, smoker, hypertension, diabetes mellitus)	–	–
	Smoking history	–	–
	Family history	–	–
	Age over 70	–	–
	Non-Caucasian	–	–
	Female	–	–
	Symptoms not related to movement stresses associated with somatic low back pain	–	–
	Abdominal girth < 100 cm	0.91	0.64
	Presence of a bruit in the central epigastric area upon auscultation	–	–
	Palpation of abnormal aortic pulse	0.88	0.56
	Aortic pulse 4 cm or greater	0.72	–
	Aortic pulse 5 cm or greater	0.82	–

Adapted with permission from the *Journal of Orthopaedic and Sports Physical Therapy.* 2012;42(4):A1-A57. doi: 10.2519/jospt.2012.42.4.A1.29

Table 2.

Yellow Flags		
Problem	**Signs and Symptoms**	**Measurement Tool**
Psychiatric Disorders	Previous history of psychiatric disorders	History
	Anxiety that back problems are dangerous	FABQ/TSK/PCS
	Anxious, depressed, stressed, social withdrawal	Beck Depression Index
	Somatization; patient does not sleep well because of back pain	History
Socioeconomic Issues	Occupation related: heavy lifting, uncertain work demand, unsociable working hours, high mental workload, prolonged time off work, forestry workers, dissatisfaction with work, lack of work support, problems with claims or compensation, no economic gain from resuming work	History/Job Description/Interview with Supervisor
	Social or economic hardships (eg, divorce, death in the family, job loss	History
	Overprotective family/partner, lack of social support	History
Behavior (including FAB and Kinesiophobia) and Attitudes	Inappropriate or limited belief on improvement or ability to work	Oswestry Disability/PCS
	Reluctance to improve physical level, extended rest	PCS/FABQ
	Expectation that passive treatment (physical agents, extended bed rest) is better than active participation (exercise, walking, working) to get better	Interview
	High fear avoidance behavior scale score	FABQ
	High kinesiophobia scale score	TSK
Miscellaneous	Confusion about diagnosis and prognosis, misunderstandings about the cause of pain, negative experience with previous intervention for back pain, immigration status	History

Adapted with permission from Carlos Ladeira.
Abbreviations: PCS, Pain Catastrophizing Scale; FABQ, Fear Avoidance Belief Questionnaire; TSK, Tampa Scale for Kinesiophobia

treating patients that are not responding as expected, clinicians are advised to use guidelines to determine when recommendations for imaging should be made.

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PERFORMING ARTS

SPECIAL INTEREST GROUP

President's Letter

Annette Karim, PT, DPT, OCS, FAAOMPT

Anaheim, California, February 17-20

CSM 2016 is just around the corner! The annual Combined Sections Meeting is a great opportunity for learning and connecting with others. For more information go to: http://www.apta.org/CSM/. I have highlighted some of the PASIG events below:

WEDNESDAY: At CSM 2016, the PASIG will offer a 1-day preconference course, *"Dynamic Neuromuscular Stabilization: Assessment & Management of Performing Artists,"* given by Clare Frank, PT, DPT, OCS, FAAOMPT, and me, on Wednesday, February 17, 2016, 8:00 a.m. - 5:00 p.m., in the Pacific Ballroom D, Hilton Anaheim (OR-P2-7572).

FRIDAY AM: *The Orthopaedic Section Performing Arts SIG Membership Meeting* will be held bright and early: Friday, February 19, 2016, 7:00 AM-7:45 a.m., Ballroom A, Anaheim Convention Center.

FRIDAY AFTERNOON: We will also have our regular PASIG programming, *"Life on Broadway: Care of the Professional Theatrical Performer"* by Jennifer Green, PT, MS, CFMT, and David Weiss, MD, FAAOS, on Friday, February 19th, 3:00 p.m. - 5:00 p.m., in room 304 AB, Anaheim Convention Center (OR-2C-3861). All are welcome!

FRIDAY NIGHT: *Orthopaedic Section Meet & Greet,* 6:30 p.m.-7:30 p.m., Friday, February 19, 2016, in the California Ballroom B, in the Hilton Anaheim.

The Fellowship Task Force has distributed a performing arts physical therapy practice analysis survey, and it is not too late to participate. Participation from a broad sampling of clinicians who work with performing artists is critical to the process and very much appreciated. Please contact Mariah Nierman if you have questions: Mariah.Nierman@osumc.edu.

Several positions on our Board will be open for new chairs in 2016. Please consider serving, and contact one of our Nominating Committee members. We have a lot of fun, and a little effort goes a long way, as we move forward in the areas of education, research, screening, membership, public relations, and scholarship. Please contact Elizabeth Chesarek for more information: echesarek@gmail.com.

Remember, PASIG membership is free with an Orthopaedic Section membership.

I look forward to seeing you at CSM. Please come by the Orthopaedic Section booth in the Convention Center exhibit hall and say hello!

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Case Report: Violist With Left Arm Pain

Janice Ying, PT, DPT, OCS, Glendale Adventist Medical Center – Therapy and Wellness Center

The patient was a 60-year-old professional violist who presented to physical therapy with chief complaints of left-sided scapular pain, and posterior arm pain and tingling that radiated to the dorsum of her hand. She reported an insidious onset of her symptoms that began in 1979 as she was completing her studies as a viola performance major at a prestigious music conservatory. Due to the severity of her symptoms, she eventually stopped working as a violist and went on to have a successful career working as a professional bassist (bass guitar, upright bass) without recurrence of her symptoms. The patient returned to playing the viola and violin professionally with local orchestras and teaching at a performing arts magnet school in 2005, but experienced a recurrence of her previous symptoms.

EXAMINATION/EVALUATION

At the time of her initial evaluation, the patient reported an average of 30 hours per week of playing time that was distributed between rehearsals, private and school teaching, and individual practice. She had not recently changed instruments or playing techniques, and had tried other treatment methods such as chiropractic adjustments and acupuncture without long-term results. She noted no significant changes in her recent health, and there were no red flags that indicated outside referral. She rated her pain based on the Numerical Pain Rating Scale[1] as 7/10 at worst while playing her viola, and decreased to 3/10 at best with rest and physical exercise. Her symptoms were rated significantly less with playing the violin in comparison to the viola. Recent MRI of her cervical spine revealed C5/6 central disk herniation, C7-T2 4mm R lateral herniation, and C4-5 2mm disk bulge with mild central narrowing.

Objective Findings

The patient completed the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH), which has been found to be a valid and reliable outcome measure for measuring functional limitations of people with upper-limb disorders over time.[2] The preintervention scores for the DASH and the Sports/Performing Arts Module were 29% and 62.5% disability respectively.

The physical examination included a thorough examination of the cervicothoracic region, shoulders, and upper extremities. The patient exhibited a reduction of cervical spine active range of motion (AROM) in all planes, with greatest range deficits into left lateral flexion. Left lateral flexion AROM reproduced the patient's symptoms. The patient demonstrated full, pain-free shoulder AROM in all planes, including composite AROM testing of hand behind back and hand behind head positions. The integrity of the cervical nerve roots were examined using a series of tests. The patient experienced an alleviation of symptoms with a manual cervical distraction test, and provocation of symptoms with compression applied with left lateral flexion and extension positioning.[3] No reproduction of symptoms with upper limb tension testing of the median, radial, or ulnar nerves were observed. Deep tendon reflexes of biceps brachii, brachioradialis, and triceps were within normal limits. Joint mobility assessment revealed significant segmental hypomobility of the left cervical spine and upper thoracic spine specifically at C4/5, C5/6, T2/3, T3/4 segments, as well as hypomobility and elevation of the left first rib.

Functional Examination

A key component in developing the treatment intervention for instrumentalist musicians is observing the patient while performing their functional task. The patient was asked to play one 8-bar excerpt in both sitting and standing positions while being observed and recorded for future video analysis. Video and still-frame images were taken of the patient playing from 4 different angles using the mobile application "Hudl Technique." The patient's viola was appropriately sized for her anthropometric measurements. While there are no direct studies to the effectiveness of proper instrument fitting, this was done based on string pedagogical theory.[4] She used a shoulder rest, but not a chin rest, to help her support the viola while playing, which she stated had been the way she had been playing since college. In both standing and seated positions, the patient employed significant left scapular depression and left trunk side-bend (Figure 1). As the patient continued to play during the course of the functional examination, it was observed that scapular stabilizer endurance was limited to approximately 45 seconds of playing time based on an observable gradual increase of scapular protraction on the left at this time.

TREATMENT

Based on the findings from the initial evaluation, the patient presented with signs and symptoms that fit within the category of "Neck Pain with Radiating Pain" as indicated by the Neck Pain Clinical Practice Guidelines.[5] Typically, with violinists and violists, the instrument is supported between the patient's left shoulder and mandible, allowing the distal upper extremity to be free for fingering the strings and to move effortlessly up and down the fingerboard. Because the patient was found to have significant range limitations with left lateral flexion, it was

Figure 1. Seated playing position (initial).

imperative that the initial phase of treatment was focused on attempting to improve that range to allow her to support her instrument without restrictions. In addition, there were objective findings that indicated a likely nerve root compression at C4/5, C5/6 segments on the left that were contributing to her radiating upper extremity and scapular pain.

In order to address her ROM deficits, manual therapy techniques included graded joint mobilizations of the left cervical spine to increase L cervical spine lateral flexion, 1st rib mobilization, thoracic spine thrust techniques to T3/4, T4/5, T5/6 segments (high-velocity, low amplitude thrust from a posterior to anterior direction). Self-mobilization techniques to improve thoracic spine mobility was given to the patient for maintenance of ROM gains between sessions. Therapeutic exercises were initiated to improve the strength and endurance of her core and scapular stabilizers.[6,7] Once foundational strength and endurance were achieved, exercises that mimicked the patient's playing positions were employed with a focus on integrating core, scapular, and rotator cuff strengthening (Figure 2). These functional exercises were performed in both standing and sitting in order to emulate the patient's playing positions. Special care was taken to perform all exercises within a painfree intensity and duration, and exercises were focused on increasing muscular endurance.

As mentioned above, the patient played her viola without the use of a chin rest (Figure 3). While a chin rest (on the anterior side of the instrument) is traditionally used to help support the instrument between the artist's chin and shoulder, the use of it is a very personal choice made by each individual musician (Figure 4). There are many different styles of chin rests that can be easily switched on a viola/violin and come in different heights and molds. Despite the diversity in the different types and styles of chin rests, very few violinist/violists receive proper fitting for their instruments specific to their individual needs. Similarly, the shoulder rest, which is fitted on the posterior side of the instrument, serves as a way to decrease the amount of lateral flexion required to support the instrument. In order to allow the patient to continue playing despite her clinical impairments, a foam pad was fabricated and customized based on the patient's available lateral flexion and neck length. The pad was then placed on the patient's shoulder rest in order to increase

Figure 2. Functional playing position exercise.

Figure 3. Viola with shoulder rest, without chin rest.

Figure 4. Viola with chin and shoulder rests.

the depth of the instrument and allow her to support her instrument with less cervical lateral flexion and minimize compression on the cervical nerve roots. This resulted in an immediate improvement in the patient's overall posture (Figure 5) and improved her painfree playing time.

The patient was not instructed to stop playing throughout the course of her treatment. Instead, she was encouraged to practice in shorter sessions, which were limited to 30 minutes of playing followed by a minimum of 15 minutes of rest. Mental practice, which included mental visualization of performing certain excerpts and passages,[8] was also used as a method to practice during her rest periods away from the instrument. In addition, a regular warm-up routine that did not involve playing her instrument was given to the patient, which consisted of wrist flexor/extensor stretching, pectoral stretching, and scapular squeezes.

Figure 5. Seated playing position – posttreatment, with modification of shoulder rest.

RESULTS

The patient was seen in clinic for 8 visits over the course of 6 weeks. At the end of 6 weeks, the patient was able to return to playing her viola for >1 hour without any reproduction of symptoms. She had resumed rehearsing with her community orchestra without limitations and reported a full resolution of her posterior arm pain and tingling symptoms. She continued to experience scapular and thoracic spine pain; however, this pain had reduced in intensity.

The DASH questionnaire and the Sports/Performing Arts Module were readministered to the patient. At the time of her discharge, the patient scored 10% and 31.25% disability respectively (MCID = 10.2 points[9]). Objectively, the patient had significantly increased her left lateral flexion and rotation AROM and no longer experienced reproduction of symptoms with Spurling's testing or cervical compression testing.

CONCLUSION

Working with instrumental musicians can be quite challenging due to the various types of instruments and playing styles across the board. It is crucial that a therapist, who works with this specialized population, is cognizant of the physical demands placed on the artist due to the instrument itself, as well as her playing commitments. Many of the musicians have a hyper-awareness of their playing posture and technique that can work to their benefit or detriment. Modification of a musician's playing position, technique, or instrument must be done cautiously and collaboratively with the musician in order to maximize compliance and long-term treatment effects. Specifically with the performing arts population, movement and task analysis is very important and special care must be taken to mimic the patient's playing environment as closely as possible. Further studies are required to learn more about various treatment methods in addressing playing-related injuries of instrumentalist musicians.

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President's Corner: A Quick Look

Clarke Brown, PT, DPT, OCS, ATC

Time has passed quickly while serving as President of the Foot and Ankle Special Interest Group (FASIG). For 6 years, it has been my honor and privilege to serve our members, about 700 of the most interested and qualified physical therapists who contribute to the research and care of the foot and ankle. Ensuring that this group of clinicians and academic professionals can communicate with each other to enhance the ways physical therapists can evaluate, treat, and manage foot dysfunction is the formidable purpose of our group. Since our SIG is changing leadership, NOW is the time to review our short-term past and plan for the future.

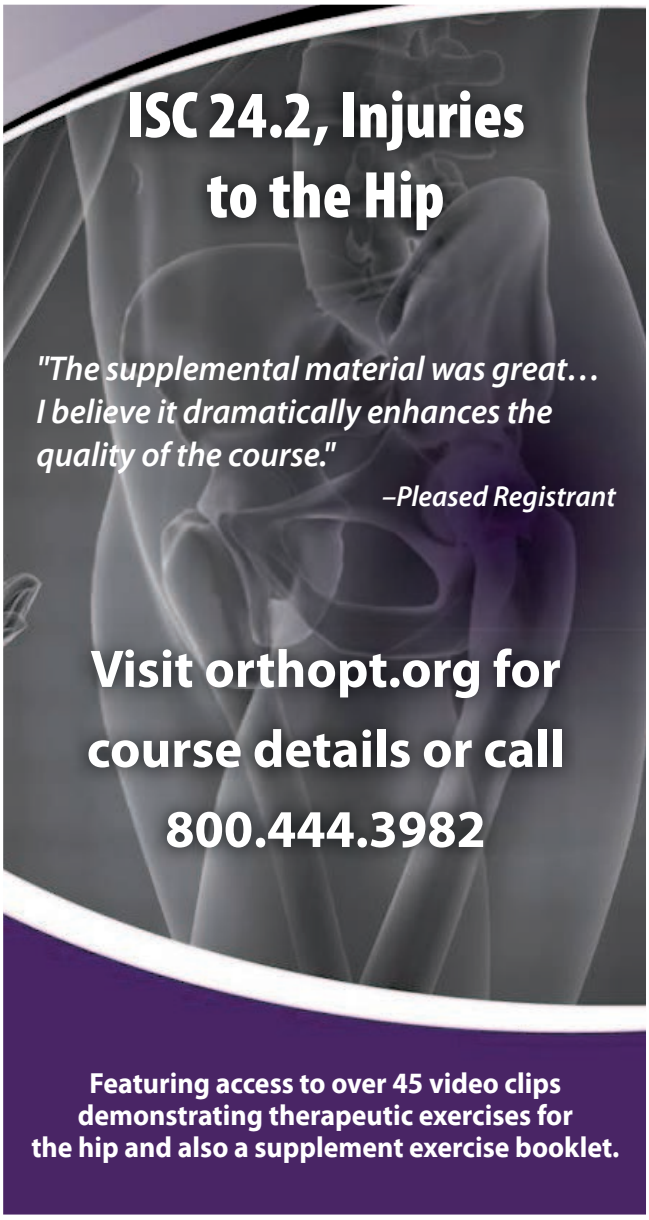
First, let me highlight a major FASIG accomplishment. Back in 2007, our previous President, Steve Paulseth, led the group and began a process of surveying entry-level physical therapy programs about the curriculum content of our physical therapy programs. The FASIG wanted to better understand what programs were teaching, and moreover, how the collective knowledge of the foot and ankle could help supplement the education of entry-level students regarding foot and ankle. The results indicated that entry-level programs would appreciate more foot and ankle information, in particular, the topics of evaluation and treatment strategies.

In 2011, the FASIG developed a Task Force to begin the process of providing additional and consistent curriculum content to entry-level physical therapy programs. Thirty-five experts in the foot and ankle gathered at APTA headquarters in Virginia to create an entire supplemental curriculum for any entry-level program that desired recommendations to assist in their current programming. Over the next 4 years, this curriculum document would be vetted, presented at CSM for further inspection, and then re-written, re-formatted, and re-written again. The end result is a fully cited, referenced, comprehensive curriculum content document available to ALL physical therapy programs. The document is downloadable to all members at the orthopt.org website.

Without hesitation, I NOW would like to offer you an opportunity to join the FASIG, or perhaps step into an officer role, because affiliating with this group can impact your career in physical therapy. My experience as President has been humbling and illuminating. By far, the most amazing aspect of the FASIG is the variety of foot and ankle conditions that the clinician is involved with. These areas include diabetic care, prosthetics, orthotics, hallux valgus, bunion care, and plantar fasciitis to just name a few. Lastly, the degree of professionalism within the FASIG is exceptional.

Where is the FASIG headed? The answer lies in the question, what do YOU want from the FASIG?

The FASIG is dedicated to the development of the physical therapist foot and ankle specialist. Yet, the direction of the FASIG is entirely up to you. Interested in certifications or fellowships? Interested in starting a conversation with another foot and ankle therapist? Need help developing a research question? ALL of these questions can be answered and so many opportunities await you in the FASIG.



PAIN MANAGEMENT

SPECIAL INTEREST GROUP

Clinical Application of Tai Chi for Management of Chronic Low Back Pain: A Theoretical Discussion

Kristine M. Hallisy, PT, DSc, OCS, CMPT, CEEAA, CTI

Assistant Professor, University of Wisconsin-Madison, School of Medicine and Public Health, Department of Orthopaedics and Rehabilitation, Physical Therapy Program, Madison, WI

Disclosure: As a long-standing proponent of Tricia Yu's Tai Chi Fundamentals® Training Program, the author is not an employee and/or stockholder in the business known as Tai Chi Health. The author does teach Tai Chi Fundamentals® continuing education workshops for personal profit and recently co-authored a book with Tricia Yu.

BACKGROUND AND PURPOSE

Chronic low back pain (cLBP) is a multifaceted biopsychosocial condition that poses a significant and costly health burden (eg, direct medical, indirect economic workforce, and quality of life costs). The lifetime prevalence of LBP is 80% to 85%, with recurrence rates ranging from 24% to 33%.[1] Compared to persons with acute and/or subacute LBP, persons with cLBP regularly use more costly health care services (eg, diagnostic imaging, spinal injections, surgery, and opioid medication) and are more likely to seek out complementary and integrative medical care.

Numerous physical, psychological, behavioral, and social factors contribute to the experience of cLBP. The International Association for the Study of Pain states that chronic pain is a worldwide epidemic fueled by several factors: (1) aging populations, (2) obesity, (3) lifestyles factors (eg, physical inactivity, nutrition, sleep hygiene, smoking, alcohol), (4) certain health conditions (eg, fibromyalgia, arthritis, depression, anxiety, mood disorders), and (5) stress from relationship problems or a history of physical, sexual, or emotional abuse.[2] Of these, the psychological (yellow flag) risk factors, such as depression, fear-avoidance, pain catastrophizing, and self-efficacy, are mitigating factors in the development and persistence of cLBP. Recognition of these challenging biopsychosocial factors has directed the medical community toward developing more psychologically-informed, multidisciplinary rehabilitation for persons with cLBP.[3]

Along with cognitive-behavioral strategies, the American College of Sports Medicine advocates aerobic exercise (muscular endurance), strengthening, stretching, and neuromuscular (functional) exercise for the conservative treatment of cLBP.[4] The 2012 *JOSPT* best practice management guidelines display strong evidence for progressive endurance and fitness activities and trunk coordination, strengthening, and endurance interventions for persons with cLBP (Table 1).[1] Tai chi chuan, an ancient (13th century) Chinese exercise, offers the clinical community a functional exercise strategy to potentially meet all of the aforementioned guidelines.

Although numerous forms of tai chi (TC) exist, Yang-style TC is the most widely practiced and researched. While current literature supports the use of TC for balance and fall prevention, chronic health conditions (eg, fibromyalgia, osteoarthritis, osteoporosis, heart disease),[5] and psychological benefits (eg, stress, anxiety, depression, and self-esteem),[6] only one randomized control trial using TC for the management of cLBP has been completed to date.[7] The purpose of this paper is to describe and discuss TC as a meditative movement therapy that can readily address the numerous biopsychosocial aspects of cLBP. This paper will discuss TC mind-body principles in the management of cLBP, provide clinicians with strategies to implement TC into physical therapy clinical practice, and outline potential research avenues for the use of TC in the management of cLBP.

DESCRIPTION OF TAI CHI

Tai chi is a mind-body exercise rooted in Chinese (13th century) martial arts. Tai chi combines relaxed, fluid, 3-dimensional movement with a calm, alert mental state. It is a non-impact exercise that develops muscle endurance, flexibility, balance, and coordination.[8] Tai chi, like yoga and qigong, is also a meditative movement therapy. Meditative movement therapies are a new category of exercise (eg, aerobic, strengthening, or stretching interventions) defined by (1) some form of movement or body positioning, (2) a focus on (diaphragmatic) breathing, and (3) a calm state of mind with the goal of deep states of relaxation.[9] Tai chi focuses on the interactions among the brain, mind, body, and behavior, with the intent to use the mind to affect physical functioning and promote health.[8]

Biomechanical Analysis of Tai Chi Movements

As a mind-body practice rooted in the martial arts, TC provides the exact exercise demands needed by the person with cLBP, ie, progressive endurance and fitness training (aerobic) with a focus on trunk coordination, strengthening, and endurance (neuromuscular control); hip and ankle mobility (flexibility); and strengthening of the lower extremity, pelvic girdle, core, and shoulder girdle. The spine is held upright and in a neutral posture at all times. The extremity movements of TC avoid end-range of motion keeping optimal length-tension relationships reducing the risk of injury. The movements of TC help the client with cLBP exercise in ranges of motion that translate directly into function.

The weight-bearing posture of TC is well-tolerated by persons with cLBP (Figure 1). The TC posture fosters integrated movement from the core (proximal stability for distal mobility). Loose-pack positioning of the knee (~25°) creates a knee flexion moment that is controlled by the muscles of triple extension—quadriceps, hip extensors, and plantar flexors. This likewise flexes the hip releasing tension in the hip flexors—particularly the iliopsoas that is frequently either short/tight or facilitated (increased tone). Tai chi posture allows the client to achieve a neutral spine and engages the core musculature. Isometric contraction of core musculature and pelvic floor stabilize head, trunk, and arms to control the center of mass and keep spinal balance at all times.

Tai chi posture can improve the muscle imbalances fre-

Table 1. Clinical Practice Guidelines: Interventions for Chronic Low Back Pain[1]

INTERVENTION RECOMMENDATIONS	LEVEL OF EVIDENCE
Centralization and Directional Preference Exercises and Procedures (repeated motions) • Improve mobility • Reduce pain symptoms	Strong evidence
Manual Therapy • Reduce pain and disability • Improve spine and hip mobility	Strong evidence
*Progressive Endurance and Fitness Activities** • To promote submaximal fitness and endurance for the management of pain in patients with cLBP • To promote health and wellness	Strong evidence
*Trunk Coordination, Strengthening, and Endurance** • To address movement coordination impairments	Strong evidence
*Patient Education & Counseling** • Promote activation philosophy • Decrease fear • Explain neuroscience of pain	Moderate evidence
Flexion Exercises (combined with other interventions such as manual therapy, strengthening exercises, nerve mobilization procedures, and progressive walking) • Reduce pain and disability in persons with chronic low back pain	Weak evidence
Lower-quarter Nerve Mobilization • To reduce pain and disability	Weak evidence
Traction • Subgroup of patients with signs of nerve root compression	Conflicting evidence
*As mind-body neuromuscular exercise, tai chi is a relevant intervention strategy for persons with chronic low back pain.	

quently seen in persons with cLBP, specifically the upper- and lower-quarter crossed syndromes. The upper-crossed syndrome creates inhibition of deep cervical flexors, lower trapezius, and serratus anterior and facilitation of upper trapezius, levator scapula, sternocleidomastoid, and pectoralis. The lower-crossed syndrome creates inhibition of abdominals, gluteals, and pelvic floor and facilitation of the iliopsoas and thoraco-lumbar extensors.[10] Tai chi postural alignment inherently addresses these muscle imbalances.

Chinese Mind-Body Principles

The 3 traditional mind-body principles foster mental alertness (centering), proper body mechanics (effective action), and integrated movement from the core (tai chi energetics). Ancient Chinese texts say that TC movement is "rooted in the feet, powered by the legs, guided by the torso, and expressed in the hands." Tai chi fosters stability (stand like a great mountain) and fluid movement (move like a great river).[8]

Guidelines for Tai Chi Practice

Mindfulness. Tai chi practice involves striving to focus on the present moment. Mindfulness is the intentional and non-judgmental focus of one's attention on the emotions, thoughts, sensations, and actions currently taking place.[8,11] A *PubMed.gov* search "mindfulness benefits" (11/19/2015) yields 24 systematic reviews touting the psychological well-being benefits of mindfulness. There is evidence for positive effect for general health improvement as well as improvement from depression,

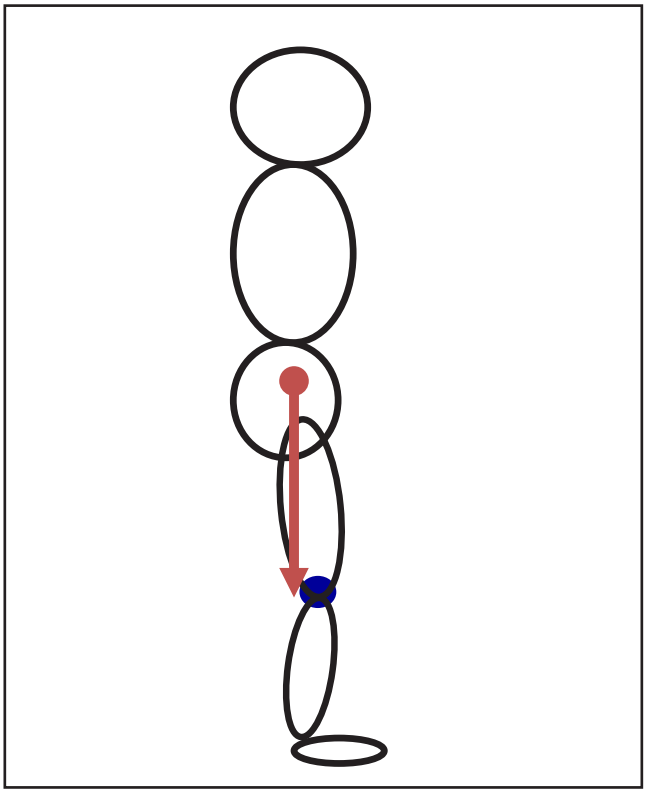


Figure 1. Tai Chi Posture – rooted in the feet, powered by the legs (quadriceps), directed by the torso, and expressed in the hands.

mental illness, anxiety, pain, and other chronic illnesses.[6]

Postural alignment. Tai chi posture (Figure 1) reminds us to maintain an upright spinal posture as we move throughout our day. The flexed knee posture readies us for action while supporting the natural primary (thoracic kyphosis) and secondary (cervical and lumbar lordosis) curves of the spine. Use of the powerful muscles of triple extension (eg, hip extensors, quadriceps, and plantar flexors) along with the 3-dimensional mobility of the hip joint further protects the spine as we use our upper extremities to complete the many tasks of our days.[11]

Breath awareness. At the center of all meditate movement therapies (eg, qigong, tai chi, yoga) is breath awareness. Persons with cLBP frequently use the diaphragm to splint the body while moving. This steals away the body's ability to efficiently oxygenate. Tai chi practice reminds us to slow down and inhale deeply to *nourish* and exhale completely to *cleanse* every cell in our being.[11] Likewise, normal respiration allows for cyclical movement of the spine—elongating the lumbar lordosis and thoracic kyphosis on inhalation and shortening the spine with every exhalation.

Active relaxation. Tai chi fosters a state of relaxed inner stillness while in motion. Active relaxation reminds us to integrate our inner calm and stillness while simultaneously taking on safe and effective physical action. For the person with a sensitized central nervous system, this active relaxation may actually assist in down regulation of the sympathetic nervous system, thus helping with pain management.

Slow movement. Tai chi movements are done slowly, deliberately, and with keen awareness. Slow movement builds strength and endurance. This allows the nervous system time to create optimal balance between agonistic and antagonistic muscles. It allows the brain time to integrate our joints, to craft the precise action we wish to accomplish. Slow movement, when repeated, and done in a relaxed way, prepares the nervous system for more dynamic, rapid, and even, ballistic functional activities. The slow movement of tai chi is the roadmap to motor efficiency and power, and precisely why many martial artists practice tai chi on the way to mastering their more explosive martial arts practices.[11]

Weight separation. Tai chi enhances dynamic control of the center of mass (postural control and balance). As a gross motor exercise, TC fulfills Sherrington's best practice guidelines for improving balance, strength, and coordination for fall prevention: (1) reduce the base of support (eg, tandem stance position and, if possible, standing on one leg), (2) move the center of gravity by controlling one's body position while standing (eg, reaching safely, transferring the body weight from one leg to the other, stepping up onto a block), and (3) reduce the need for upper limb support while in standing.[12] This renders TC a purposeful intervention in a variety of physical therapy settings—acute care, inpatient rehabilitation (subacute), skilled nursing facilities, nursing homes, outpatient clinics, and community-based programs.

Integrated movement. All TC movements are initiated by stabilizing on the weight-bearing surface and moving from the center of mass (core). Tai chi movements are based in proprioceptive neuromuscular facilitation fostering proximal stability for distal mobility. Tai chi movements can be taught in a neurodevelopmental sequence (eg, sagittal to frontal to transverse planes) allowing the learner to have incremental success, hence keeping TC safe for the client with cLBP (Figure 2). The *Tai Chi Fundamentals (TCF) Training Program* developed in conjunction with physical therapists provides an accessible program for clients of all ages and functional abilities.[13]

SUMMARY OF USE

As an integrated science, evidence-based practice (EBP) has been viewed as a 3-legged stool of the best scientific evidence, clinical expertise, and patient values and preferences. From an EBP standpoint, the scientific efficacy of TC for cLBP is still up for debate. A PubMed search using "tai chi and low back pain" (11/18/15) reveals 18 (n=18) articles (2003-present), with most (n=13) in the past 5 years. Only a few randomized control trials (n=5) exist with only one specifically using TC for the treatment of pain and disability in people with cLBP.[7] Furthermore, Tai Chi seemed to be an effective intervention for LBP, osteoarthritis, and fibromyalgia syndrome with less evidence for rheumatoid arthritis and headaches.[14]

Since 2007, an outpatient physical therapy clinic at the University of Wisconsin Hospitals and Clinics has been using simplified yang-style TC as the basis for a *Movement Awareness & Exercise Class for Patients with Chronic Conditions*. This group TC class (6 one-hour weekly sessions) is part of an interprofessional pain management clinic (MD, PT, psychology) that is attempting to foster optimal wellness for persons with chronic pain through client empowerment. Participants (n ≅ 300) have ranged in age from 11-90 years (female > male). Clients were predominantly persons with chronic musculoskeletal pain (eg, LBP, osteoarthritis, FMS, and pelvic floor dysfunction) and the occasional client with neurologic diagnoses (eg, Parkinson's disease, multiple sclerosis, stroke).

Each class consists of a warm-up, TC training, and a meditation/qigong cool-down. Participants are trained using the 3 components of the *TCF Training Program*: (1) mind/body principles and guidelines for TC practice (previously discussed), (2) TCF movement patterns (Figure 2) and (3) TCF form practice.[13] Short-term outcomes from this TC exposure class have been monitored via simple tests and measures done at the beginning and end of the 6-week session. Outcomes include improved weight-bearing tolerance (as monitored by number of seated rest breaks and overall time seated/lying down per training session), improved single-leg standing balance (4-stage balance test), increased leg strength and transfers (30-second stand to sit chair test), decreased pain ratings over single treatment and over the course of the training sequence (Visual Analog Scale ≅ 2). Patient-specific functional improvements have been monitored on an individual basis as well as or changes by outcome tools specific to diagnosis (eg, Oswestry for cLBP, fibromyalgia impact scale, etc.).

To date, this movement awareness class based on the medical model *TCF Training Program* has been well accepted by physicians, clients, and insurance companies in the Madison, Wisconsin, area. Because TCF was developed in collaboration with physical therapists, it provides a clear developmental progression for mastering Tai Chi basics and a gateway to all traditional TC lineages (styles). Likewise, because the local area is rich with TC programs, it is possible for clients to proceed from this exposure class to community-based TC programs. Clients are provided with home exercise programs, but can also purchase a TCF training DVD and/or written materials.[6,16]

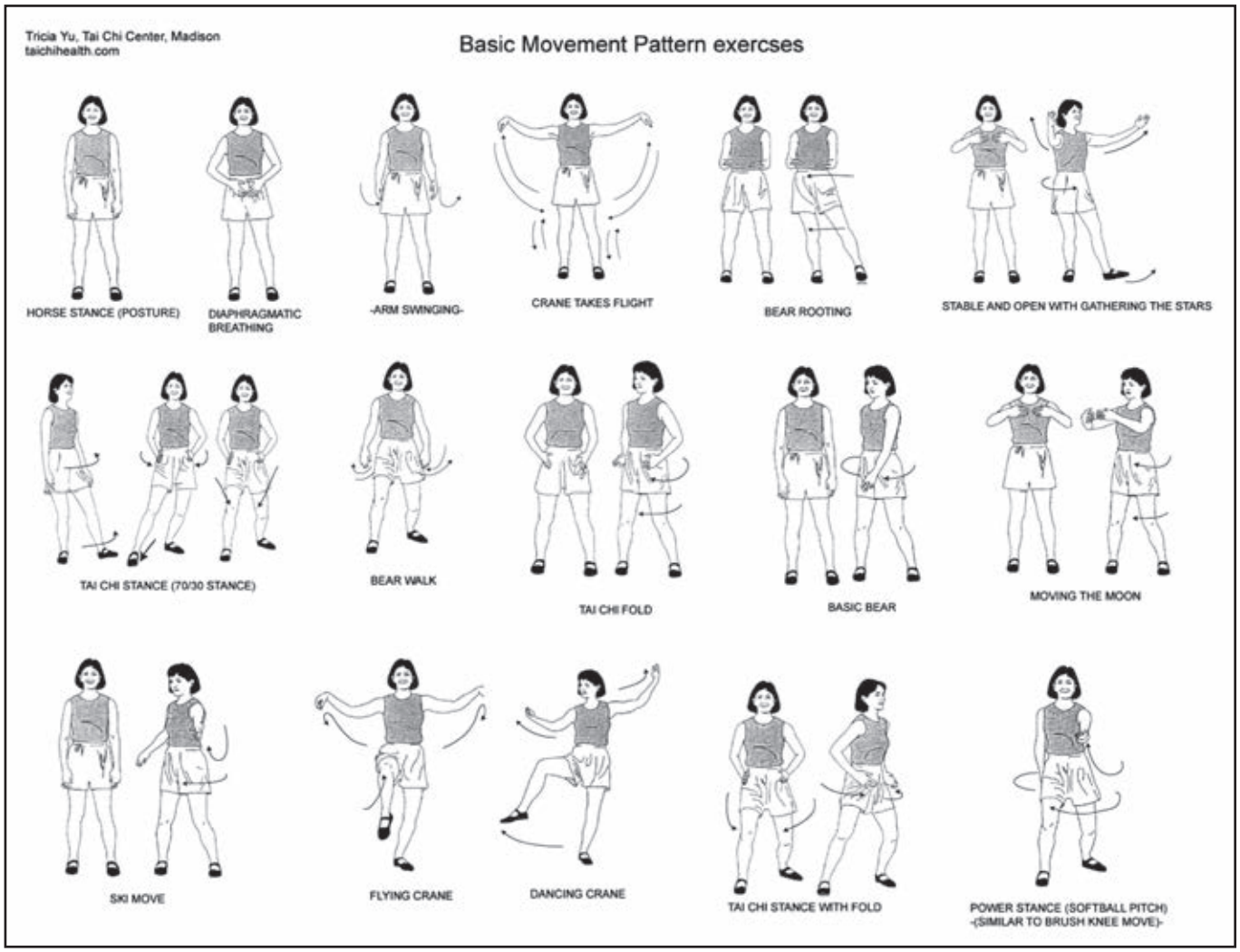


Figure 2. Tai Chi Fundamentals movement patterns.

Tests and Measures Applicable to Tai Chi Practice

Whether employing tai chi interventions in research, clinical, or community-based practice environments, researchers and clinicians are obligated to measure functional baselines and monitor the progress of patients/clients. Table 2 displays common intervention categories, suggested tests and measures, physical therapy management goals, and dosing parameters applicable to monitoring clients engaged in TC practice.

What to Expect at the Initiation of Tai Chi Practice

Tai chi participants should be informed that muscle soreness, specifically delayed onset muscle soreness (DOMS) in the antigravity muscles of the body, is an expected feature of starting any weight-bearing exercise program. Mechanically, the muscles of the anterior thigh (eg, knee extensors or quadriceps) will experience the greatest amount of DOMS. Other antigravity muscles that are commonly challenged with TC practice include gastrocnemius-soleus complex, gluteals (hip extensors and abductors), spinal extensors and abdominal muscles (transverse abdominis and obliques), and scapular stabilizers. Tai chi participants should expect that with graded exposure to muscle activation via the squatting, weight-shifting, and single-leg-stance activities of regular tai chi practice, the duration and intensity of DOMS will decrease over time.[11]

From the literature, it appears that TC is safe. A systematic review of an adverse event (AE) in randomized trials evaluated 153 eligible randomized control trials (mostly older adults). Only 50 eligible trials (33%) included reporting of AEs; of these, only 18 trials (12% overall) reported an explicit AE monitoring protocol. While TC is unlikely to result in serious AEs, it may be associated with minor musculoskeletal aches and pains (eg, knee and back pain).[15] It is the opinion of the author (KH) that since TC practice promotes posture, mental concentration, and is done in a slow and controlled fashion, it is safe for patients with chronic health conditions.

CLINICAL RELEVANCE

Physical activity and exercise is relevant to the client with cLBP. Aerobic exercise, strengthening, flexibility, and function (neuromuscular) are indicated for persons with cLBP to improve function (Figure 2).[4] As a mild-to-moderate form of aerobic exercise, TC is a therapeutic intervention suitable to a wide range of health care conditions and diseases. The weight-bearing posture of TC readily addresses impairments of the lower extremities and spine (eg, muscle strength, flexibility, balance, bone mineral density) thereby improving function and

Table 2. Categories of Exercise: ACSM Guidelines for Management of Chronic Low Back Pain

INTERVENTION CATEGORY and SUGGESTED TOOLS	PHYSICAL THERAPY MANAGEMENT GOALS CONDITION	MODES and DOSING PARAMETERS
Aerobic fitness (endurance) • 6-min or 2-min walk • 400 m walk • Step test Ancillary measures • Blood pressure • Heart rate • Respiratory rate • Body-mass-index	• Increase VO_2 max and ventilatory threshold • Increase peak work and work rate and endurance • Control blood pressure at rest and during exercise • Improve coronary artery disease risk factors • Increase caloric expenditure	Large muscle activities (walking, cycling, aquatic therapies, tai chi) • 60-80% peak heart rate • 40-60% VO_2 max • rate of perceived exertion 11-16/20 • 3-5 days/week (daily+) • 5-10 minutes progressing to 30 minutes; emphasize duration over intensity
Strength training • Chair test (30-second sit-to-stand) • Functional squats (reps to fatigue, good form)	• Increase strength of trunk and extremities • Improve posture and postural muscles • Maintain bone mass • Decrease fall risk	Circuit training, free weights, resistance bands • 60-80% 1RM • 1 set of 8-12 reps • 2-3x/week Body weight resisted exercise can be used to achieve functional goals.
Flexibility • Thomas (hip flexors) • 90/90 hamstring • Ely (quadriceps) • Straight leg raise or Slump test (neural)	• Increase and/or maintain painfree ROM • Decrease stiffness	Individually prescribed stretching for muscles of interest. Neural dynamic (on/off gliding of nervous system) added as needed.
Neuromuscular control (functional/ balance) • ABCs • 10-M Walk test • Dynamic gait index • Functional reach • Single-leg balance • Timed Up & Go (TUG)	• Improve balance • Improve gait • Improve activities of daily living	Older adults (65+ years of age) at risk for falling should engage in neuromuscular (balance) exercise 2-3x or more days per week.
PSYCHOSOCIAL ASSESSMENTS can also be useful for the client with chronic low back pain • Fear-Avoidance Beliefs Questionnaire (FABQ) • Self-Efficacy for Exercise Scale (SEE) • Tampa Scale of Kinesiophobia (TSK)		

enhancing the patient/client's societal participation. Muscle contraction from the large muscle groups of the body are targeted in TC and can act as a pain-gate via endorphin release (endogenous analgesic effect). The meditative aspect of tai chi can be particularly helpful in addressing personal (psychological) factors that impact health. Furthermore, simplified and adapted forms of TC ensure that patients/clients with varying functional capabilities (eg, sitting, standing with side support, standing with walker support or free-standing) can readily engage in solo or group TC practice and profit from its many physical, mental, psychological, and social benefits.[11]

While research has validated the benefits of TC practice for many health conditions, few studies validate its use for individuals with cLBP. Still, TC has biological plausibility for the treatment of cLBP (clinical evidence) and has been shown to be valued by our clients/patients. Tai chi delivered on an individual- or group-based format in the clinic (or a community-based format) offers a functional exercise strategy to meet the challenges of cLBP. As a meditative movement therapy, tai chi is one example of a broad range of self-management mind-body exercise programs that may be beneficial for persons with persistent pain.

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IMAGING

SPECIAL INTEREST GROUP

President's Message

Douglas M. White, DPT, OCS, RMSK

As I prepare for my final CSM as your President, I reflect on how far we have come advancing imaging in physical therapist practice, education, and research. In 1993, I published a piece on diagnostic imaging in physical therapy.[1] It was clear to me then that imaging is an important tool for physical therapist patient management especially as the profession was moving toward universal direct access to physical therapists. Much has changed in 22 years. Direct access has largely been achieved. Payment policy is moving towards paying for value that makes the physical therapist's ability to optimally diagnose and manage our patients even more important. No longer can we just recognize red flags and refer out for work-up. To provide value and practice efficiently, we are assuming a greater role in managing our patients beyond our direct interventions. We are living in an age of huge disruption from newspapers to digital, from taxis to Uber/Lyft, from paper journals to smart phone instant access to the world. Imaging technology has changed too. Ultrasound has moved from the radiology department to the bedside, the athletic field, battlefield, and space station. Following typical technology trajectory, ultrasound units are much less expensive and are now portable while image quality and other software advancements are reshaping how imaging is used. Physical therapists are adapting too; though some more than others and as in all times of great change some want to hold onto the familiar of the status quo. Society is expecting us to adapt and imaging is appropriately becoming a larger part of future of physical therapist practice.

In 2008, Drs. Deydre Teyhen, Wayne Smith, and I met at CSM and hatched our plan to develop an Imaging Special Interest Group (ISIG). Approaching 8 years later, we have accomplished a great deal. Highlights from the last 8 years include:

- 240 members of the ISIG
- Imaging programing every year at CSM
- Attended a Point-of-Care Ultrasound Forum sponsored by the American Institute of Ultrasound in Medicine that resulted in *AIUM Practice Guideline for the Performance of Selected Ultrasound-Guided Procedures*[2]
- Hosted a forum on Ultrasound Imaging and Scope of Practice at CSM 2012
- Provided the genesis for *Diagnostic and Procedural Imaging Curricula in Physical Therapist Professional Degree Programs*[3]
- Developed case study and imaging pearl feature for every issue of *Orthopaedic Physical Therapist Practice*
- Formed a Research Committee
- Published the *Imaging Educational Manual for Doctor of Physical Therapy Professional Degree Programs* available at www.orthopt.org
- Successfully lobbied the American Registry for Diagnostic Medical Sonography to reverse their position and continue to have the Registered Musculoskeletal Sonography (RMSK) credential open to physical therapists
- Organized a strategic planning meeting scheduled for CSM 2016

I am proud of the exceptional team of physical therapists in the ISIG I have worked with over the last 8 years, and I am confident incoming leadership will continue to do great things to advance imaging in physical therapy.

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C3-C4 Retrolisthesis: The Importance of a Thorough Examination

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The patient was a 56-year-old female referred by her primary care physician to outpatient physical therapy for neck pain and radicular symptoms to just proximal to the left elbow. Lateral radiographs of the cervical spine revealed retrolisthesis of C3 on C4 with normal vertebral heights along with normal spinal canal (Figure 1). Cervical radiculopathy is a common finding in individuals with degenerative cervical spondylolisthesis.[1] The patient's physician recommended mechanical traction as the primary intervention.

Figure 1. Lateral radiographic view of cervical spine demonstrating C3 on C4 retrolisthesis.

The patient denied any previous injury to her neck or shoulder and reported pain provocation with sleeping on her left side and with overhead arm movement. Examination revealed sway-back and forward head posture, rounded shoulders, bilateral inferior scapula border winging at rest, and a 5/9 Beighton score. The patient's pain was reproduced with anterior and posterior apprehension testing of shoulder, resisted left shoulder external rotation, and with empty can test. Active cervical rotation was greater than 60° bilaterally. Special testing of neck revealed a negative Spurling's test, no reduction of symptoms with cervical distraction, and a negative left upper limb tension test A. Palpation of the neck revealed increased prominence of the C3 spinous process and increased localized pain.

Overall findings from the clinical exam demonstrated multidirectional left shoulder instability and localized mechanical neck pain due to poor posture. Without a thorough history and physical examination, the patient may have received suboptimal treatment based on the radiographs alone. The patient did not meet any criteria of the diagnostic clinical prediction rule for cervical radiculopathy.[2] Physical therapy plan of care consisted of postural education and strengthening of the deep neck flexors, trunk stabilizers, shoulder girdle, and rotator cuff. The primary complaint of localized cervical pain resolved by the second visit with education to improve posture and a home exercise program. The patient yielded a clinically significant change on self-reported outcome measures including the Neck Disability Index and Disabilities of the Arm, Shoulder, and Hand before self-discharging. Radiographic evidence of structural demise does not always correlate with patient symptoms.

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Case Report: Avulsion Fracture of the Ischial Tuberosity

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BACKGROUND

Regardless of the medical diagnosis, imaging should be reviewed by the treating therapist when available. Although not nearly as common,[1] an avulsion fracture of the ischial tuberosity may be considered a differential diagnosis of a chronic hamstring strain. Rossi and Dragoni[2] reported 203 pelvic avulsion fractures were identified in 198 male and female adolescent athletes with focal traumatic symptoms. Of those fractures, 53.7% occurred at the ischial tuberosity.

DESCRIPTION

The patient was a 16-year-old male high school football player referred to the primary author for a chronic left hamstring strain. The original injury occurred 3 months earlier during a summer football camp, in which the patient heard a "pop" while performing a quick stop and pivot. Radiographs were originally interpreted as negative by the patient's original orthopaedic physician (Figure 1). The patient presented to the initial physical therapy examination with continued pain (6/10 Numeric Pain Rating Scale) when sprinting, weakness (4/5 hamstring manual muscle test), and difficulty squatting, cutting, and playing football as a running back and strong safety.

Figure 1. Anterior-to-posterior radiographic view of the left and right ischial tuberosities. Notice the crescent-shaped osseous formation indicated by the arrow. Although this suggests an avulsion fracture, this radiograph was originally interpreted as negative by the original orthopaedic physician.

His Patient Specific Functional Scale (PSFS) was 8 out of 30 (sprinting 2/10, squatting 2/10, and cutting 4/10). Prior to the initial physical therapy examination, an MRI was scheduled for one week hence by a second orthopaedic physician. Therapeutic exercises with an emphasis on eccentric hamstring activities were provided. These included "Nordic hamstring" exercises.[3,4] One week later, the patient reported "some improvement" and less difficulty with sprinting. The patient returned to limited participation in high school football. Results of the MRI obtained later that week revealed an osseous avulsion type injury at the left ischial tuberosity with complete separation of the bony fragments by approximately 1.2 cm with a fluid-filled gap (Figure 2). The primary author received the original radiographs at this time, two weeks following the initial physical therapy examination (Figure 1).

OUTCOMES

Conservative treatment was continued with excellent results. The patient returned to full participation including competition 6 weeks following the initial physical therapy examination (final PSFS: 30 out of 30).

DISCUSSION

This case report demonstrates the importance of independently obtaining and reviewing available diagnostic imaging in a timely manner. Furthermore, this case highlights a positive outcome through interventions intended for rehabilitation of a chronic hamstring strain and not specifically for true diagnosis of an ischial tuberosity avulsion fracture. Had the radiograph been available for review during the initial physical therapy examination, the plan of care would likely have included more conservative interventions initially. A consult with the referring physician would have been warranted.

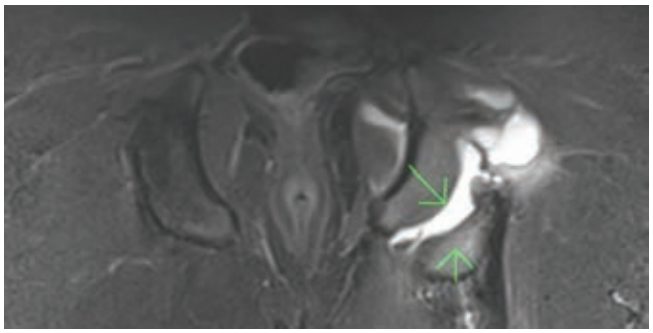

Figure 2. Magnetic resonance imaging without intravenous contrast of the left and right ischial tuberosities demonstrating an osseous avulsion type injury at the left ischial tuberosity.

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ANIMAL REHABILITATION

SPECIAL INTEREST GROUP

President's Message

Kirk Peck, PT, PhD, CSCS, CCRT

APTA Combined Sections To Highlight Elite Level Equestrian Show Jumping

The APTA Combined Sections Meeting is around the corner and as always I urge you to please join fellow colleagues in an outstanding opportunity to expand your knowledge in animal rehab. The ARSIG is sponsoring a very exciting 2-hour programming session to be held on Thursday, February 18. Two distinguished speakers will share practical experiences on the topic of Olympic level equestrian show jumping with an emphasis on both horse and rider.

Sharon Classen, PT, has recently been selected as the first physical therapist to serve on the High Performance Team for the United States Equestrian Federation, and the only credentialed physical therapist for the International Federation of Equestrian Sports. She will present on the intricacies of equine sport performance from a biomechanical point of view. Mark Revenaugh, DVM will co-present to offer a veterinarian's perspective on equine evaluation, pathology, and rehabilitation. Dr. Revenaugh has extensive experience in equine sports medicine including competition at the Olympic level. Do not miss this golden opportunity to engage in an exciting collegial exchange of ideas.

Animal Rehabilitation Collaborative Summit

In early December, I had the privilege to participate in the first organized animal rehabilitation collaborative summit held in Phoenix, Arizona. The summit included representatives from the ARSIG, the American Association of Rehabilitation Veterinarians (AARV), and the American College of Veterinary Sports Medicine and Rehabilitation (ACVSMR). The purpose of the meeting was to address issues concerning the practice of animal rehabilitation by physical therapists and veterinarians, including what constitutes "ideal" models of practice between the two professions. The dialogue signified a positive step for the ARSIG in meeting one of its primary goals, and inspired future collaborations with the veterinary profession on a national level.

Practice Analysis Update

The Practice Analysis Task Force continues to move forward with efforts to assess the current state of animal rehab in the United States. I will admit it has been a challenge to stay on task in finalizing some key documents required to survey members of the ARSIG due to other obligations, but rest assured the committee is forging ahead.

California Veterinary Medical Board

The California Veterinary Medical Board (VMB) finally held a public hearing on September 10th for the proposed regulatory language to mandate "direct supervision" over physical therapists (PTs). The Board encountered an overwhelming response in opposition to the proposed regulations with only a few individuals testifying in support. As a result, the Board withdrew the regulations. This action signaled a HUGE victory for PTs in California, and technically for PTs practicing on animals in all states.

I want to thank all the PTs, PTAs, Vets, and public members in California who shared their testimonies in opposition to the proposed regulations. These efforts made all the difference in the final outcome. I especially want to thank Karen Atlas for her incredible push to the end in motivating and encouraging so many individuals to support the cause. I also want to thank Tanya Doman for providing over 10 years of political negotiations to help ensure animal rehab in California by PTs may continue to grow without the addition of unnecessary restrictions to practice. It is truly amazing how a few individuals can truly move mountains in political advocacy if stricken with a proper dose of emotional fortitude and sense of purpose.

Evidence in Action

Please welcome a new scholar to the ARSIG family. Cynthia Kolb, PT, MPT, CCRT, submitted an excellent case study printed in this edition of *OPTP* that is a must read. Cynthia responded to a call for submissions in the last newsletter and has offered an excellent insight into a rarely discussed topic in canine rehab, fear avoidance.

Future Communications

If there is a topic of interest or something you personally believe should be brought to the attention of ARSIG members, please let me know. I am more than happy to entertain new ideas or thoughts on what members might enjoy reading as part of the *OPTP* publication.

The Science of Equine Excellence & Grace!

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A Case Study of Fear Avoidance in a 4.5-year-old Labrador

Cynthia Kolb PT, MPT, CCRT

A study performed in April 2013 by the Research Group on Health Psychology in Leuven, Belgium focused on the thought that "the mere intention to perform a painful movement prior to the actual painful movement itself can come to elicit conditioned fear responses."[1] The fear-avoidance (FA) model of musculoskeletal pain has become an increasingly popular conceptualization of the processes and mechanisms through which acute pain can

become chronic.[2] Many studies have been conducted using the FA model in relation to adults dealing with pain with more recent studies using the same paradigm in children to assess and evaluate pain-related fear. Few studies have translated these findings into the rehabilitation of animals. The focus of this case report is based on a 4.5-year-old, NM Chocolate Labrador who initially incurred a mechanical injury that manifested into a pain-related fear and avoidance behavior, which in turn resulted in a decline of functional activities at home.

Havoc was sent to the Certified Canine Rehabilitation Therapist (CCRT) with a diagnosis of "lameness left hind leg (LHL)." The DVM reported that radiographs were performed with no significant findings related to lameness. Other past medical history was unremarkable. Owners stated that Havoc had attempted to climb over a 10' wooden fence to escape the yard, and fell on his "backside." Since then, he refuses to ambulate 12 basement steps that lead to the top level of the house. In order to bring Havoc upstairs, they must walk him outside to the front of the house. During cold or rainy days, they carry the 80 pound Labrador up the basement steps in their arms.

Physical exam findings were as follows:

Gait: Havoc slows the velocity of his gait down when going up hills, and prefers to zig-zag back and forth in a wide path to come back up the hill. He displays a slightly shortened stride on the left hind leg due to decreased knee extension with stepping. He is able to turn bilaterally.

Strength/Function: Trendelenburg was (-) bilateral hind limbs (BHL). Discomfort noted with left hind limb and right front limb cross stance. He is independent with all transfers supine to sit to stand and reverse. Lameness issue appears with steps. As far as walking endurance, Havoc was able to run on level ground and play without signs of fatigue or lameness.

Neuro signs/tests: Conscious proprioception (CP) present, withdrawal present all 4 limbs.

Palpation/Range of Motion/Joint Glides: Front limbs within normal range of motion (ROM). Left hamstring – 40% normal ROM, right hamstring – 50% normal ROM. Tenderness noted T3-L1 paraspinals, R >L. Tenderness to right 1st rib with mobilization. Caudal rotation noted of the left sacroiliac joint. Tenderness/pain with palpation L piriformis > R piriformis, also at the L sacrotuberous ligament (no tenderness R).

Peripheral Joints: BHL: cranial drawer (-), patellar subluxation (-), hip dysplasia (-).

Treatment: Hamstring stretches to BHL 20 to 30 seconds x 5 reps with demonstration to owner, who correctly demonstrated back to therapist. Sacroiliac joint (SIJ) gapping to the left side, SIJ ventral traction technique followed by Grade II-III mobilizations x 20 oscillations. Grade III mobilizations dorsal to ventral (D/V) to T1-L3 with right rotational component. Trigger points noted in right latissimus dorsi with trigger point massage used. Class 3b LASER 5-6 Joules/cm^2 with 500 mW probe to the left and right SIJ and piriformis, left sacrotuberous ligament. LASER 3-4 Joules/cm^2 with 500 mW probe to the R and L paraspinals T1-L3, to trigger point areas in R latissimus area.

Assessment: Havoc is an extremely healthy and energetic lab with a wonderful temperament. He is slow to show signs of discomfort, but does show reactiveness when assessing the SIJ. Some of this mechanical dysfunction of the SIJ is due to tight hamstrings, L > R. On flat surfaces, very little gait abnormalities are noted except for lacking knee extension on the left (again due to the tight hamstring). It is with activities that involve shifting the weight backwards onto the hind legs (stair climbing and hill climbing) that Havoc slows down and shows signs of discomfort, due to the mechanical dysfunction of the SIJ. The reactiveness in the paraspinals shows that Havoc is pulling more with the front limbs to off-weight the hind legs. Havoc's owners are very eager to have him back to his full potential.

Goals: 4 weeks

(1) Havoc will be able to run up the hill in the backyard with equal stride length in the rear without signs of discomfort or lameness.

(2) Havoc will have decreased tenderness noted in the SIJ with palpation, with equal alignment bilaterally.

(3) Havoc will be able to perform stairs without signs of discomfort or lameness in order to go to the top floor.

Plan: Owners were given a copy of the hamstring stretches to perform daily. See Havoc in one week.

The following was a progress note from the visit performed one week later:

Patient: Havoc Date: 10/05

S: "I've worked with him every day on his hamstring stretches. He seems to move better to me. He still gets nervous when I walk to the basement steps to go upstairs. He just runs around and around in circles and lifts up that back left leg."

O: Passive ROM to hamstrings. Tenderness noted on the left piriformis with cranial strumming, and to the sacrotuberous ligament. No tenderness right side. Rotational component noted of the iliac crests with left side lower (by 3/16th of an inch as compared with 6/16th on initial exam). Sacroiliac joint gapping to the left side, SIJ thigh thrust treatment technique, and SIJ ventral traction technique followed by Grade II-III mobilizations x 20 oscillations. T10-L3 reactive to palpation along the R paraspinals. Grade III mobilizations D/V to T1-L3 with right rotational component. Trigger points noted in right latissimus dorsi; trigger point massage used. Class 3b LASER 5-6 Joules/cm^2 with 500 mW probe performed as in initial evaluation.

Exercises: 6 Cavaletti poles at 8" high placed on a slight incline outside the owner's home. Havoc initially bunny-hopped in rear, but after approximately 8 attempts, Havoc demonstrated 80% accuracy for alternating the hind legs. This was added to Havoc's home exercise program. (1) Front limbs elevated on a 6" block, luring with treats. He was able to hold this position without discomfort. The right hind leg was then elevated, for a count of 32 sec x 4 reps. Havoc was then asked to step up and over/down on the box multiple times with proper muscle control and timing used. (2) Havoc was then taken over to the 3 front steps with the therapist sitting on the top step and Havoc's feet at the step below the therapist, back legs on the ground. Right HL lifted and held for a count of 30 x 5 reps without signs of discomfort or pain. The owner was encouraged to perform this exercise with Havoc on the steps, with praise and rewards. After this exercise, Havoc was taken up and down the front 3 steps for 7 reps without signs of discomfort or pain.

A: Improvement noted today in the symmetry of Havoc's SIJ and improved ROM of the hamstrings. Havoc's overall flow of movement is improved, but he is still anxious with weight shift-

ing to the hind legs. Havoc was able to perform the Cavaletti poles with improved accuracy with repetitions. Havoc had no difficulty after treatment climbing the front steps to the home, even when performed over and over again. Havoc may have conditioned himself to be afraid of the basement steps, because he is certainly anxious with just the thought of them. Asked owner to take Havoc over to the neighbor's and work with him on their steps, or to build some temporary steps for him to try.

P: Reassess Havoc in 2 weeks and progress him as needed.

Progress note at 2 weeks:

Patient: Havoc Date: 10/29

S: "I've been gone on business so I haven't had the time to work with him that much. I have been doing the 3-legged stand with his front end up on a step like you showed me. It's gone well and he tolerates it a lot better."

O: Hamstring stretches to (B)HL 20-30 seconds x 5. Slight tenderness noted on the left piriformis with cranial strumming, and to the sacrotuberous ligament. No tenderness right side. No rotational component noted of the iliac crests. T10-L3 presents with reactiveness to palpation along the R paraspinals, but after Grade III mobilizations D/V to T1-L3 with right rotational component and then reassessed – no tenderness or reaction noted. Class 3b LASER 5-6 Joules/cm^2 with 500 mW probe to the left piriformis, left sacrotuberous ligament. LASER 3-4 Joules/cm^2 with 500 mW probe to the R paraspinals T1-L3.

Walked with Havoc over to the basement stairs, and he started to get anxious, running in small circles while lifting his LHL, then was taken away from the stairs. A 'lickety stik' was used to coax Havoc up the first 4 steps – no signs of pain or lameness noted as Havoc gaited up and down the first 4 steps to a landing. Coaxed Havoc again up the next 7 steps with the 'lickety stik' with Havoc getting anxious and wanting to run back down, but turning back for the treat. Havoc followed the therapist up the last 7 steps for the treat, ran back down to the very bottom and back up for the 'lickety stik' again - all without signs of lameness or discomfort in the hind limbs.

A: Continued improvement in Havoc's SIJ, decreased compensation noted in the paraspinals with only slight tenderness, relieved with manual therapy. Limited ROM in the R hamstrings. Havoc exhibits fear avoidance behavior, but with his mind focused on the treat, he was able to forget his fear and quickly.

P: Owner to continue working with Havoc on his fear avoidance behavior, using treats as a motivation, and to continue passive range of motion to the hamstrings.

Email sent on 11/04 from Havoc's owner:

Cindy,

Just wanted to thank you so much for working with Havoc! He is now coming up the steps all by himself!! Before you started working with him, I thought he was headed for surgery. Thanks again!

Havoc has continued to perform all stairs without difficulty or hesitation. One of the advantages of making house calls is seeing the patient in their own environment. If Havoc had been seen at the office, this display of fear avoidance behavior would not have been witnessed. More research needs to be conducted along the lines of fear avoidance behavior in animals and how this can affect their rehabilitation process. Interestingly, ongoing studies in the literature indicate a strong connection between a parent's psychological response and a child's interpretation of pain cues. That parent behaviors may also amplify child cognitions about the threat value of pain and promote increases in pain-related behavior and avoidance.[2] A question for animal rehab practitioners to keep in the back of our minds is *how can this parent/child relationship of fear avoidance* be applied to our 4-legged children that are known to be very perceptive about the emotions and feelings of their owners (2-legged parents). Again, there remains a need for much research and insight into this area.

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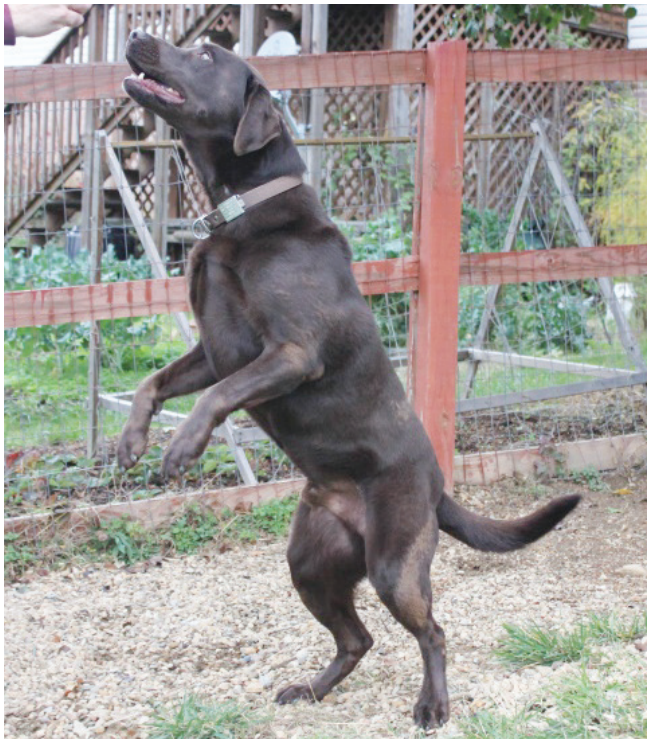

Havoc on his last CCRT visit, demonstrating full weightbearing on the bilateral hind limbs.

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