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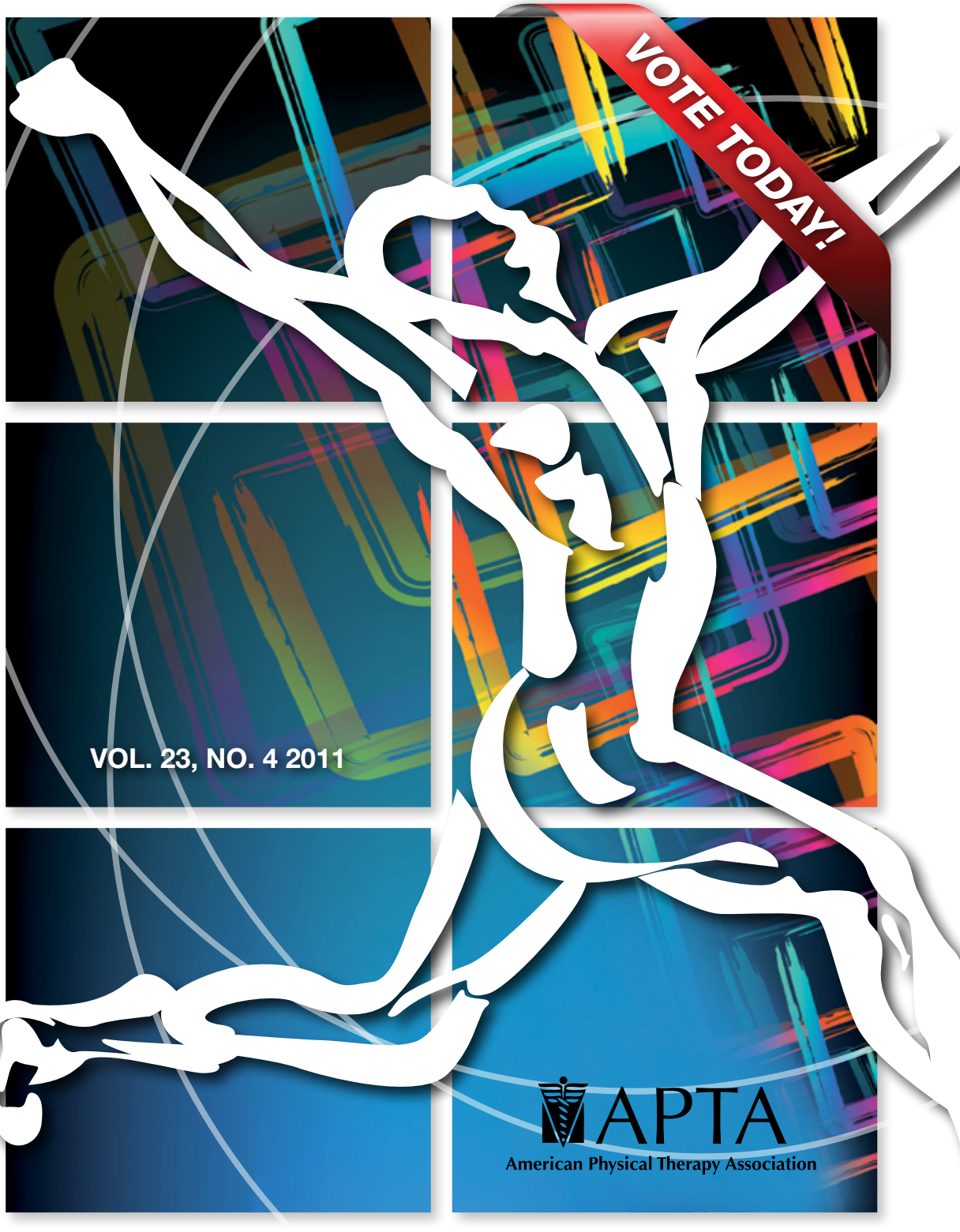

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University of Pittsburgh
Department of Orthopaedic Surgery
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Orthopaedic Section Web site:
www.orthopt.org

Bulletin Board feature also included.

Office Personnel

(800) 444-3982

Terri DeFlorian, Executive Director
x204 ..... tdeflorian@orthopt.org
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School of Physical Therapy
Slippery Rock University
Slippery Rock, PA 16057
(724) 738-2757
chrisjhughes@consolidated.net

Managing Editor:
Kathy Olson
(800) 444-3982, x213
kmolson@orthopt.org

ORTHOPAEDIC PRACTICE
Editor:
Christopher Hughes, PT, PhD, OCS
School of Physical Therapy
Slippery Rock University
Slippery Rock, PA 16057
(724) 738-2757
chrisjhughes@consolidated.net

Managing Editor:
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JOSPT
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Milwaukee, WI 53201-1881
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(414) 288-5987 (Fax)
guy.simoneau@marquette.edu

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Guest Editorial

A New Form of Physical Therapy: Regenerative Rehabilitation

Fabrisia Ambrosio, PhD, MPT;[1] Anthony Delitto, PhD, PT, FAPTA[2]

[1] *Assistant Professor, Department of Physical Medicine and Rehabilitation & Director, Cellular Rehabilitation Laboratory, University of Pittsburgh, Pittsburgh, PA*

[2] *Professor and Associate Dean of Research, School of Health and Rehabilitation Sciences, University of Pittsburgh, Pittsburgh, PA*

You have just received an outpatient PT referral; yet, this referral is unlike others you have had in the past. The referral is for a 19 y.o. male s/p biological scaffolding transplantation to repair a large, traumatic muscle defect. This individual was on active duty when an explosion resulted in a volumetric loss of his quadriceps muscle. Following nearly 2 years of physical therapy, this young man's weakness (28% of his contralateral side) and functional deficits (decreased ambulation endurance and inability to descend stairs) persisted. Three and a half years after injury, he underwent an innovative surgical approach involving transplantation of a small intestinal submucosal extracellular matrix scaffold into the injured area. This scaffold is a tissue engineering tool designed to regenerate and restore functional muscle tissue in cases of severe muscle loss. As the attending physical therapist, you have been charged with the task of designing and implementing a rehabilitation care program that maximizes the functional incorporation of the transplanted material.

While it may seem like such a case represents a hypothetical scenario of the distant future, such a clinical application of regenerative medicine strategies represents a present-day reality.[1] In fact, musculoskeletal regenerative medicine approaches have the potential to considerably change medical practice, and open up an exciting new population of patients for rehabilitation specialists. Other examples include stem cell therapies for the treatment of myopathies and cartilage repair or the transplantation of organs and tissues grown in vitro.

Regenerative medicine represents innovative medical technologies that are being developed to repair, replace, or regenerate injured, aged, or diseased tissues. As these cutting edge approaches are rapidly translated to the clinic, the critical question arises, *"are we, as physical therapists, prepared to implement targeted and specific care plans that will maximize functional efficacy of these biological therapies?"*

Why physical therapeutics may be critical for the success of these regenerative medicine approaches.

A primary goal of physical therapy is to maximize the functional capacity of weakened, damaged or diseased tissues, primarily by optimizing the intrinsic healing and growth response of the body. Such a goal is often attained through the application of mechanical stimuli to elicit specialized tissue responses, including but not limited to, growth factor secretion, angiogenesis, and cell proliferation. We propose that the paths of rehabilitation and regenerative medicine should increasingly intersect based on the fact that many of these same tissue responses have been implicated as key factors determining successful outcomes after scaffold transplantation, cell therapy, or artificial device delivery. From the basic scientist's perspective, common approaches to address these physiological tissue needs are to directly inject growth factors or to genetically engineer cells to respond in the intended manner, for example. However, it may be argued that applied mechanical forces represent a unique opportunity to communicate with the transplanted materials in a noninvasive and cost-effective fashion. Indeed, recent studies conducted in mouse models have demonstrated that coupling stem cell transplantation with early initiation of a muscle loading protocol significantly enhances donor cell engraftment and regenerative potential,[2-4] thereby potentially overcoming a major barrier to the translation of these therapies for the treatment of skeletal muscle injuries and diseases. For biological scaffolds, mechanical stimulation of the transplant site is similarly critical for efficient remodeling.

In order to effectively design a comprehensive care program that will maximize the functional efficacy of the scaffold transplantation, pre-clinical trials are needed in order to establish optimal timing and dosing for the initiation of rehabilitation protocols. The only way such trials may be conducted is by collaborating efforts across rehabilitation and regenerative medicine scientists at the early stages of technology development. Synergy between the two fields must be realized at conceptualization and development, such that by the time the technology reaches the individual, protocols for implementation have already been clearly defined.

While a needed synergy between the two fields may seem conceptually obvious, obstacles to the integration of regenerative medicine and rehabilitation undoubtedly exist. Interdisciplinary research and practice is desirable, but such an endeavor is made more difficult because, unless opportunities for interaction exist, individuals from each of the represented fields remain stuck in their own disciplinary attitudes. To date there has been a lack of a common forum from which professionals from each field may exchange ideas and initiate collaborations. In addition, there is an increasing need for the incorporation of regenerative medicine principles and latest research findings into physical therapy educational programs. Only in this way, will the up-and-coming therapist be prepared to treat this exciting new and ever-growing population of patients.

For more information regarding Regenerative Rehabilitation, or to register for the First Annual Symposium on Regenerative Rehabilitation (November 3-4, 2011), please visit: www.mirm.pitt.edu/symposium

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Evaluation and Treatment of Cervicogenic Headache: A Case Study Using Interventions of Soft Tissue, Joint Mobilization, and Stabilization Exercises

Jong T. Park, PT, DPT, MTC

Coordinator of Physical Therapy, Mettler Center, Champaign, IL

ABSTRACT

Background and Purpose: This case report describes a 73-year-old male that started to experience headaches that had been increasing in intensity and frequency around the temporal areas of his head. A description of a treatment approach is presented involving soft tissue and joint mobilization with appropriate joint stabilization to the dysfunctions that can contribute to cervicogenic headaches (CGH). **Methods:** The patient was treated with use of soft tissue and joint manipulation to the thoracic spine and subcranial region, passive stretching, middle/lower trapezius strengthening, cervical stabilization exercises, instruction in a home exercise program, and postural education. **Findings:** The patient was symptom free with his everyday activities. There was a significant decrease in his pain rating scale from 8/10 to 0/10 at worst. **Clinical Relevance:** Improvements in CGH, cervical active range of motion (AROM), deep cervical flexor strength, subcranial motion, and upper thoracic spine motion were present in this patient through manipulation and stabilization.

Key Words: manual therapy, stabilization, cervical spine, cervicogenic headache, posture

INTRODUCTION

Up to 50 million Americans suffer from headaches. Headaches are prevalent in 70% of American families, affecting at least one family member. Patients have been referred to physical therapy with adjunct treatments ranging from oral medications, biofeedback, stress management, and the use of transcutaneous electric nerve stimulation units. Though these concurrent treatments might control headache symptoms, they have not necessarily addressed the anatomical and structural reasons for headaches.[1]

There are several different forms of headaches ranging from classic migraine headaches to cluster headaches, as well as headaches resulting from vascular problems and tumors. Migraine headaches occur mostly in females, can be related to family history, and triggered with stress. Symptoms can include scotoma. Cluster headaches occur mostly in males with associated symptoms of sweating, tearing, salivation, and rhinorrhea. Vascular headaches are usually intermittent and become worse with changes in cerebrospinal fluid pressure. There is usually no relief and the headache stays in the same location. Headaches associated with tumors usually involve focal neurological disturbance and can lead to seizures and coma. These forms of headaches have a poor prognosis for relief through physical therapy. [2(p 3)]

By far the most common headaches are cervicogenic headaches, which represent referred pain from the cervical region that is perceived in any part of the head. They can be caused by a primary nocioceptive sources in the musculoskeletal tissues innervated by cervical nerves, such as muscles, joints, capsules, or ligaments. These types of headaches seem to have the greatest potential for relief through physical therapy.[3(p 184)]

The general characteristics of cervicogenic headaches are that they are usually unilateral, the duration lasting from several hours to weeks, and can be severe in nature. The location can vary from the frontal, temporal, and orbital regions. Aggravating factors include sustained postures and trauma, with symptoms including neck pain and stiffness secondary to joint and muscular dysfunction. Associated symptoms may include phonophobia or photophobia with nausea and vomiting, but these are more prevalent with migraines.[2(p 137)]

Some researchers have considered the role of posture and exercises in cervicogenic headaches. McDonell et al[4] speculated that posture deviation can lead to cumulative microtrauma of the cervical region and negatively affect deep neck cervical flexor endurance and strength, which can lead to cervicogenic headaches. Thus, their approach of rehabilitation is to stabilize the cervical spine.

Other researchers have considered the role of joint mobilization in the treatment of cervicogenic headaches (CGH).[5] One of the reasons for the effectiveness of manual intervention has been that it can improve joint motion and control for pain better than performing exercises alone.[2(p 3)] The role of posture awareness, exercises, and mobilization all seem to play a part in decreasing CGH.

The purpose of this paper is to describe the examination and treatment of a patient with CGH and to take a closer look at CGH and the effect of soft tissue and joint mobilization with cervical stabilization exercises for improving posture and decreasing cervicogenic headaches.

CASE DESCRIPTION

The patient is a 73-year-old male that was referred for physical therapy secondary to increasing intensity and frequency of headaches in the temporal area of his head the past several weeks. He was referred by a family doctor with a medical diagnosis of cervicogenic headache.

Chief Complaint

The patient described his symptoms as a heavy aching in the temporal area of his head and also at the base of his skull. The patient stated that his left temporal pain seemed greater than the right. He rated his pain at 8/10 at worst, 3-4/10 at best (Figure1). His symptoms usually seemed to worsen by the end of the day, but he also had experienced pain in the morning and for the rest of the day. He also noted "popping" and "cracking" when rolling his neck, more often by the end of the day. He denied any dizziness, nausea, radicular symptoms, or loss of strength of his upper extremities. He also denied any visual

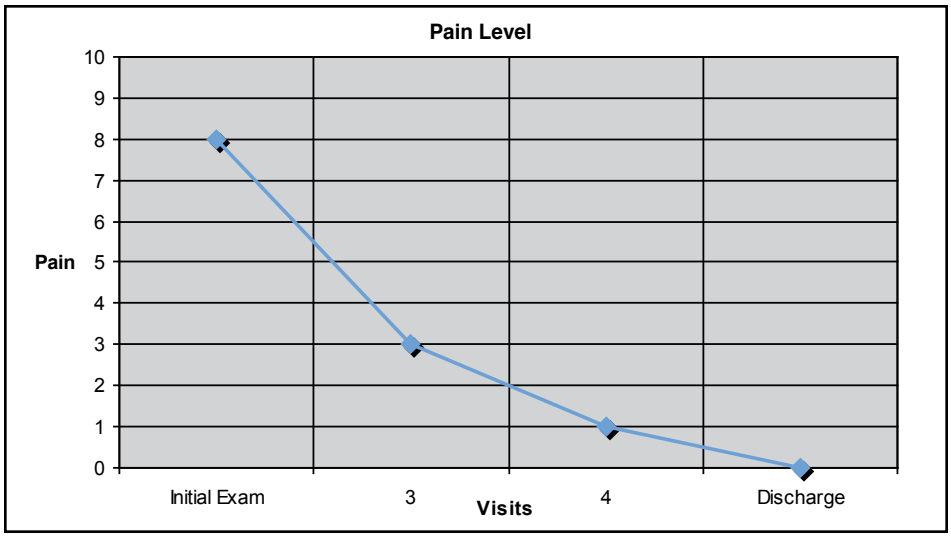

Figure 1. Pain level from initial examination to discharge.

or hearing difficulties, dysphagia, or paresthesia. He had been able to sleep without any problems apart from the days that his headaches reached a pain level of 8/10.

Aggravating Factors

Activities that worsened his symptoms included reading his newspaper for prolonged periods for which he requires bifocals. He has also had more frequent headaches with increased yard work or after pulling weeds from his lawn. He has noticed that his upper back and shoulder areas tend to "tighten up" with increased use of his arms to pull and lift. He also states that he recently installed hardwood floors in his living room, which he reports have made his headaches worse.

Past History and Intervention

The patient stated that he has been managing his headaches for the past 20 years. He used to work lifting boxes of about 20 to 30 lbs onto an assembly belt throughout the day. He states that during those years he would stretch his arms and shoulders in the mornings before he went to work, in order to relieve stiffness. He managed his symptoms in the past with acetaminophen and ibuprofen, which gave some relief. The patient has seen his primary physician and recently undergone radiography of the cervical spine and computerized tomography scan of the head. Results revealed moderate degeneration of the mid-cervical joints.

Functional disability

The patient's functional disability was assessed with the Neck Disability Index (NDI), before his treatment sessions and at the time of discharge. The NDI has exhibited reliability and validity in evaluating the progression and regression of a person's cervical functional ability. The scores range from 0 to 50. A score of 0 indicates no disability and a score of 50 indicates the most amount of disability. The patient's score prior to treatment was 22, indicating a moderate disability.[6]

Patient's Goals

The patient's goals were to return to his gardening, home improvement activities, and reading with fewer episodes and less intensity of his headaches. He states that he would like to enjoy his retirement by being active and not be limited by his headaches.

Differential Diagnosis Based on the Subjective Examination

The patient's dominant unilateral temporal symptoms, the postural factors influencing his headaches, and the patient's symptom frequency and location were consistent with cervicogenic headaches. The patient had also complained of aggravating factors such as increased yard work or pulling weeds, activities that required use of his scapular retractor muscles. These activities, along with increased episodes of headaches since installing his new floor, led to the contention that potentially weak scapular retractors, along with extension of the upper cervical spine, may have played a role in his headaches. Thus, the initial hypothesis is that upper thoracic and upper cervical postural dysfunction has contributed to the patient's cervicogenic headaches. The physical examination was conducted with this hypothesis in mind and the cervical spine, thoracic spine, and the relationship of the soft tissue and joint restrictions were considered. The stability of the mid-cervical joints was examined as well.

Differential diagnosis included migraines. They, however, tend to produce phonophobia, photophobia, nausea, and vomiting. The lack of these symptoms shows that this patient most likely does not have migraine headaches. The patient's neck fatigue with prolonged sitting postures can be due to lack of cervical endurance, strength, and decreased postural awareness and correction. The patient's complaints of "popping" and "cracking" in the neck can suggest that joint dysfunction or degenerative changes are contributing to his headaches.

PHYSICAL EXAMINATION

Structure/Posture

The patient did not exhibit any noticeable postural deviations during observation from sitting in the waiting room to walking to the examination room. Standing postural assessment revealed a forward head posture with increased thoracic kyphosis. He presented with rounded shoulders with elevation of the left scapula. He also exhibited compensatory left mid-cervical side bending and right upper cervical side bending secondary to the position of his left scapula. In sitting, his forward head posture with upper cervical extension was accentuated.

Active Movements

Shoulder flexion was slightly limited without reproduction of symptoms. His thoracic kyphosis and slight forward head posture probably contributed to his limited shoulder AROM since decreasing his thoracic kyphosis resulted in his bilateral shoulder flexion improving to within normal limits.[7] It also resulted in a decreased end feel and increased tightness of the soft tissues. Reaching behind the back with his left upper extremity towards the spine revealed a slight decrease in scapular protraction.

Assessment of subcranial AROM[2(pp 25,26)] by observation, revealed limited subcranial flexion and bilateral subcranial side bending. He was then instructed to look up towards the ceiling as verbal cues for subcranial extension. He did not exhibit significant limitations of extension. He was instructed to bend his neck forward, backwards, and to bring his ear towards his shoulder to

examine his mid-cervical AROM.[2(pp 26,27)] The measurements were made using a goniometer using the landmarks established by Norkin and White.[8(pp 188-198)] Active mid-cervical forward bending was limited at 30°, left side bending limitations at 22°, right side bending at 24°, left rotation at 42° to the left and 45° to the right.[8] Cervical extension caused increased pain at end range within functional limits (Table 1).

The vertebral artery test used to check for vertebral artery compromise was negative.[2(pp 62,63)] Transverse ligament and alar ligament tests were negative.[2(pp 59,60)]

Palpation for Mobility

Passive intervertebral motion of the mid-cervical spine was assessed with patient in supine for rotation and side bending restrictions with passive sideglides in either direction with contact on the articular pillars.[2(p 31)] Passive intervertebral motion assessment in side bending revealed slight restrictions in right facet closing of C3-4. His headaches were not reproduced on the right side with testing of the right downglide of C3-4. Left C3-4 facet closing as well as all the other mid-cervical joint motions were normal (3/6), based on the 0-6 scale by Paris.[9(p 317)] Passive subcranial forward bending assessment revealed considerable restricted movement (1/6) and reproduced headache symptoms for the patient. Subcranial extension did not reveal significant restrictions. Taking the patient to end range in the subcranial left sidebending increased his headaches with slight restriction in movement (2/6). Testing of atlanto-axial (AA) rotation with the neck fixed in nonphysiological side bending revealed slight restriction in left rotation greater than right rotation at 2/6.[2(p 70)]

The patient was assessed for upper thoracic mobility with passive motion testing for sidebending, backward bending, and rotation as well as first rib depression.[2(pp 85-92)] Testing revealed bilateral limitations of rotation and backward bending at levels T1-5. Left first rib elevation was present with limited inferior motion with assessment of the patient in the supine position.

Manual Muscle Testing

Upper trapezius, middle trapezius, and lower trapezius strength were tested according to Kendall.[10(pp 284-286)] Testing revealed strength of 4/5 for both left and right upper trapezius. Lower trapezius strength and middle trapezius strength were 3+/5 bilaterally. Strength of muscles innervated by C2-T1 was 4/5.[11] The patient's deep cervical flexors were tested with nodding of the upper cervical with mid-cervical forward bending by curling the head up.[12(p 43)] Weakness was noted with cervical flexion while lying supine. The motion sometimes involved a slight backward bending of the upper cervical spine with compensatory contractions of the sternocleidomastoid and scalene muscles. The strength of the deep cervical flexors was 3/5 (Table 2). Strength of cervical backward bending in prone was 4+/5, associated with minimal pain in the suboccipital region.

Table 1. Cervical Motion from Initial Examination to Discharge

Cervical Motion	Initial Examination AROM	3rd Visit AROM	4th Visit AROM	Discharge AROM
Flexion	30°	35°	38°	38°
Left Sidebend	22°	24°	28°	30°
Right Sidebend	24°	28°	32°	32°
Left Rotation	42°	45°	49°	48°
Right Rotation	45°	46°	48°	50°

Table 2. Middle/Lower Trapezius and Deep Cervical Flexor Strength from Initial Examination to Discharge

	Initial Evaluation Strength	3rd Visit Strength	Discharge Strength
Middle/Lower Trapezius	3+/5	3+/5	4/5
Deep Cervical Flexors	juddering	juddering	4-/5

Muscle Length and Palpation

Tightness of upper trapezius and levator scapulae were assessed, but these tests did not increase the patient's headaches. Muscle length testing for pectoralis major and minor tightness was noted bilaterally.[10(pp 62,63)] Tenderness was present in right suboccipital region; left more than right with moderate pain on palpation. There was tenderness with palpation of the right semispinalis capitis and longissimus. The patient presented with hypertonicity of left temporalis, both scalenes, levator scapulae, and left masseters with palpation. He also had tenderness with palpation of thoracic paraspinals, bilateral, from T1-5 (Table 3).[13(pp 26,27)]

Differential Diagnosis Based on the Physical Examination

The physical examination confirmed the diagnosis of cervicogenic headache. The patient presented with posture related pain, active cervical ROM and passive intervertebral motion limitations, limitation of thoracic and first rib motions, poor muscle recruitment of the deep cervical flexors, and limited scapular stabilization. The use of bifocals during reading seemed to further exacerbate his symptoms, possibly secondary to the increased upper thoracic flexion and upper cervical extension. Compression of the cervical facets as well as the occipital nerve could give rise to his symptoms increasing during those activities.

Poor posture can result in limitation of intervertebral movement as well as decreased stability of the scapulae. The patient exhibited limited control during cervical flexion with poor quality of motion that involved juddering. He also presented with decreased strength, which was noted with compensatory backward bending of the upper cervical spine. These are possible contributors to the headaches, especially during sustained postures in his daily activities. The increase in headaches, with testing of passive intervertebral motion (PIVM) of the upper cervical and subcranial region, possibly indicates referred pain from the soft tissues, articular surfaces, or headache secondary to occipital nerve irritation or compression.[3(pp 184,185)]

The patient presented with limitations in thoracic mobility in left and right rotation. These limitations can affect the mid-cervical positioning and limit subcranial joint mobility. Passive intervertebral motion testing revealed limited mobility of the upper thoracic and upper cervical spine. Cervicogenic headaches can be attributed to pos-

tural issues arising from these impairments.

The prognosis is good and the expectation is that the patient will benefit from physical therapy including manual therapy to decrease myofascial restrictions and increase upper cervical and thoracic mobility, therapeutic exercises to improve muscular flexibility and cervical stability, posture education, and instruction in a home exercise program (HEP).

COURSE OF TREATMENT AND OUTCOMES

The patient was seen for 6 visits within 4 weeks after the initial examination, for a total of 7 visits. Treatment consisted of manual physical therapy, therapeutic exercises, posture education, and a home exercise program for decreasing myofascial restrictions, improving upper cervical and thoracic mobility, improving mid-cervical stability, and improving his functional abilities.

The problem list for the patient as found in Table 3 was as follows:

1) Increased tonicity of left temporalis, bilateral scalenes, right semispinalis, right longissimus, bilateral thoracic paraspinals, bilateral levator scapulae, and left masseters.
2) Headaches during prolonged sitting and reading. Headaches with PIVMs of the upper cervical spine.
3) Limited cervical AROM in side bending and rotation.
4) Limited subcranial and upper thoracic intervertebral motions.
5) Decreased deep cervical flexor, middle trapezius, and lower trapezius strength and endurance.
6) Decreased muscle length of bilateral upper trapezius, levator scapulae, pectoralis major, and minor muscles.
7) Limited education and limited ability for self correction of sitting posture and other activities to decrease episodes of CGH.

Treatment Goals:

1) Decrease hypertonicity of affected musculature in 1 to 2 weeks.
2) Decrease headaches associated with prolonged sitting, reading, and assessment of the upper cervical to 0-1/10 in 2 to 3 weeks.
3) Improve cervical AROM by 5° in 2 to 3 weeks.
4) Restore subcranial and upper thoracic mobility to decrease its contribution to CGH in 2 to 3 weeks.
5) Improve deep cervical flexor and trapezius strength to 4- to 4/5 without compensatory patterns in 2 to 3 weeks.
6) HEP to maintain muscle balance of tightened myofascial regions in 2 to 3 weeks.
7) Improve posture education during activities that exacerbate symptoms and be able to correct posture to avoid symptoms in 2 to 3 weeks.

Table 3. Problem List at Initial Examination and Outcomes at Discharge

Initial Examination	Discharge
Increased tonicity of left temporalis, bilateral scalenes, right longissimus, semispinalis capitis, bilateral thoracic paraspinals, bilateral levator scapulae, and left masseters.	Minimal hypertonicity of affected musculature.
Increased headaches in prolonged sitting and reading positions.	Decreased headache pain to 0/10 in sitting and reading positions for 2-3 hours.
Limited cervical AROM in side bending and rotation.	Improved cervical mobility in all direction.
Limited subcranial and upper thoracic intervertebral motions.	Subcranial and upper thoracic spine has normal (3/6) mobility in previously restricted joints.
Decreased cervical flexion, middle trapezius, and lower trapezius strength and endurance.	Improved cervical deep flexor and trapezius strength to 4- to 4/5 without compensatory patterns.
Decreased muscle length of bilateral upper trapezius, levator scapulae, pectoralis major, and minor muscles.	ndependent HEP to maintain good muscle balance of tightened myofascial regions.
Limited awareness and self correction of sitting posture and activities.	Independent posture awareness and correction.
Neck Disability Index score of 22.	Neck Disability Index score of 6.

After the initial examination, the patient was instructed about activities that can potentially increase the intensity and frequency of his headaches. Also, the role of posture in compounding the current mechanical dysfunctions was explained. This was for the purpose of assisting the patient to recognize that the overall treatment approach will involve self-awareness and change of his current condition.

In the first two visits after the initial examination, the emphasis was on improving mobility of the upper thoracic spine, upper cervical spine, and the associated soft tissue structures. Manual intervention in the first and second visit consisted of myofascial techniques for the suboccipital muscles with inhibitive distraction.[2(pp 39-44)] This intervention involves the therapist placing their finger tips, in a vertical position, along the occipital area distal to the muscular insertions and proximal to the atlas. With the front aspect of the therapist's shoulder contacting the patient's forehead, there is a distraction force in the longitudinal direction. Laminar release[13(p 43)] of the thoracic muscles was conducted in sitting. The therapist used the tip of the thumb and PIP joint of the index finger to stroke longitudinally along the thoracic paraspinals while the patient moved into forward bending. Also, the therapist used soft tissue mobilization for the bilateral levator scapulae, left temporalis, bilateral scalenes, right semispinalis capitis, right longissimus, and left masseters. During the soft tissue treatments, the patient experienced symptoms that referred to the temporalis, upper back, and lateral arm consistent with patterns described by Travell.[14] Left and right AA rotation were facilitated in sitting by blocking the lamina of the axis with the thumb. The other arm was used to turn the head towards the restricted direction.[2(p 80)] Unilateral atlanto-occipital (AO) nods were conducted in supine in order to improve the upper cervical motion.[2(p 78)] T1-5 were mobilized in left and right rotation in prone with grade 4 mobilizations in coordination with his breathing.[15] Mid-thoracic tilt was performed with the patient in prone to facilitate backward bending. This technique involves the therapist using their pisiform on the thoracic spinous process to facilitate an impulse at the patient's end range. This force is imparted as the therapist takes up the slack

as the patient exhales. Left first rib depression was performed in coordination with his breathing, which decreased the restriction of the descent of the rib.[2(p 92)] Also, as the tightness of the scalenes decreased, the first rib appeared to exhibit a less elevated position.

At the third visit, the patient stated that the intensity of his headaches had decreased significantly to 3/10 (see Figure 1). He stated that cervical mobility was also improving and that he had noticed a decrease in headaches at the end of the day. Assessment of the cervical AROM revealed improved flexion to 35°, left sidebending to 24°, right sidebending to 28°, left rotation to 45°, and right rotation to 46° (see Table 1). Assessment of his subcranial flexion and side bending by observation, revealed better quality of movement, without noticeable deviations or abrupt stops. He was still able to reproduce his headache symptoms when attempting subcranial movement to end range.

At this time, the emphasis was placed on scapular retractor strengthening and endurance training for his deep flexor cervical musculature. Scapular retraction was performed in sitting with a yellow/moderate level resistive band while instructions were given to "squeeze" the scapulae together. He was able to perform 10 repetitions for 2 sets before the onset of fatigue.

The deep cervical flexors were activated with instruction to nod his head and then lift his head, maintaining the neck in a neutral position as he lifted his head.[16] The sternocleidomastoid and scalene muscles (SCM) were palpated for excessive use and observed for any apparent overuse.[17] The patient was able to perform 10 repetitions at 5-second hold, with minimal physical cues to limit SCM and scalene activation, with some juddering. This exercise was conducted with the following visits and progressed to 10 seconds without compensation or substitution.

By the fourth visit, his pain level had decreased to 1/10. His active cervical flexion was 38°, left sidebending was 28°, right sidebending was 32°, left rotation was 49°, and right sidebending was 48° (see Table 1). During this visit middle and lower trapezius strengthening in the prone position was continued.[10(pp 282-287)] The patient was able perform two sets for 10 repetitions but required physical cues for proper mechanics and movement. Also, the manual techniques were the same as prescribed for the previous visit.

By the fifth visit, the patient was not experiencing any headaches. He exhibited better control of the scapular retraction and was able to progress to two sets of 15 reps of scapular squeezes with the shoulder in 90° abduction and lateral rotation in the prone position. He was also exhibiting good body awareness and movement awareness of his deep flexor stabilizers and scapular retractors. He was able to maintain a 10-second hold of the position for 10 repetitions. At this point the patient was instructed to continue with these exercises as part of his HEP. Upon retest of the middle and lower trapezius, the strength was rated at 4/5 bilaterally (see Table 2). Prone position grade 4 rotation mobilizations to T1-T5 were performed to increased thoracic mobility and did not aggravate his headache. Mid-thoracic tilt facilitated backward bending. Subjective observational reassessment of his upper cervical motion revealed slight limitations of cervical flexion. Treatment was followed with OA nod in supine followed by distractive inhibition. The OA nod involves the therapist placing the middle finger on the posterior arch of the atlas and using the opposite hand to create a nod for improved OA forward bending.[2(p 78)] He was instructed on stretches for the scalene, levator scapulae/upper trapezius muscles, and how to perform upper thoracic extension while sitting in a chair as part of his HEP.[18] He was instructed to perform all the stretches for 5 repetitions with 30-second holds twice a day.

His last visit was rescheduled for 7 days after the fifth visit so that he would continue with his exercises and management of his headache independently. By the sixth visit, the patient had met all his goals. He rated his headache pain level at 0/10 without any episodes of headaches during the past 7 days. He had continued to exhibit improved cervical flexion at 38°, left sidebending at 30°, right sidebending at 32°, left rotation at 48°, and right rotation at 50°. Assessment of his mid-cervical, subcranial, and thoracic spine PIVM revealed improvements in movements that were previously restricted to normal (3/6). His previous soft tissue muscle hypertonicity was minimal. His middle and lower trapezius strength was 4/5 bilaterally and cervical flexor strength was 4-/5. He stated that he was able to sit and read for up to 2 to 3 hours without an increase in his headache symptoms. The patient's functional disability was remeasured through NDI. His score decreased from 22 to 6, indicating a mild disability.[8]

The patient felt confident that he would be able to manage his symptoms with his understanding of his headaches. The patient was instructed to continue in his HEP every other day; instructions relating to activities, aimed at preventing his headaches from recurring, were reinforced. The patient had follow-up calls once a month for the next two months. At two months, he reported minimal episodes of headaches and felt confident in how he was managing his condition.

DISCUSSION

This patient's signs and symptoms were consistent with the definition of cervicogenic headaches as described by the International Headache Society's Headache Classification Committee.[19] The patient's pain was primarily in the suboccipital muscles, the masseters, and the temporalis regions. The pain was exacerbated with sustained postures, such as reading the newspaper. He presented with limited physiological and segmental motion in the upper cervical spine. He also had limitations of thoracic spine mobility and first rib mobility.

The patient's pain patterns and related dysfunction were similar to findings by Dreyfuss and Edeling,[20,21] who correlated the dysfunction of the cervical vertebrae and related soft tissue to CGH symptoms. Cervicogenic headaches have also been linked with degenerative changes in the cervical region, particularly the OA and AA joints, which can cause limited mobility, and cause compression in the subcranial region.[20,21] Some structures known to affect CGH are the intervertebral disc, C2-C3 annular fibers, joints, ligaments, muscles, and C1-C3 innervated structures.[22] Cervicogenic headaches have also been linked with the dysfunction of the semispinalis and the longissimus.[14] The attachment of the semispinalis from C7 to T7 and insertion into the nuchal line of the occipital region and the attachment of the longissimus capitus from T1-T5 transverse process and insertion to the posterior aspect of the mastoid give credence to this possibility.[23(pp 160-164)] Also, the greater occipital nerve pierces throughout the semispinalis capitis, leading to possible compression of the nerve.

The sympathetic nervous system has also been known to play a role in CGH. The sympathetic nervous system innervation to the head and the neck initiate from the T1-T2 and T3-T4 spinal levels.[23(p 199)] Along with posture correction, reduced mechanical pressure of the sympathetic nervous system through mobilizations in the upper thoracic

can lead to a decrease in CGH.[24]

Deficiencies in deep flexor muscles have been known to increase CGH.[25,26] The causes for this are probably mechanical in nature. The muscular system plays a part to control joint motion in the "neutral zone" with the changing loads in this area. But if these muscles are dysfunctional, the joint control is affected and can increase headaches. Limited capability of the deep cervical flexors to control the mid-cervical region can affect a person's ability to maintain a good sustained posture in dynamic activities.

Other studies have considered how posture and upper crossed syndromes contribute towards CGH. The upper crossed syndrome as defined by Janda as the tightness of the upper trapezius, pectoralis major, levator scapulae, combined with weakness of rhomboids, middle/lower trapezius, serratus anterior, deep neck flexors, and scalenes. Janda referred to this as an upper crossed syndrome because of the "x" pattern that formed between the shortened and weakened muscles.[13(pp 15-22)] This can result in dysfunction of the shoulders and scapula with increased elevation and protraction, with a forward head posture; a postural deviation that may increase the possibility of CGH.

This case study demonstrates the relationship between soft tissue and joint dysfunction and cervicogenic headaches. The treatment approach aimed at restoring movement, using joint mobilization, stretching, muscle strengthening, as well as postural education. The patient progressed well in the first two visits with joint mobilization and soft tissue treatments for the purpose of improving the mobility of restricted joints. With the increase in the subcranial joint motion, as well as the thoracic spine and the first rib, his headache symptoms decreased. His pain decreased to 3/10 at worst by the second visit after the initial examination (see Figure 1).

In the third visit, in spite of the decrease in headaches, the patient still had difficulty with quality of control during neck flexion. The patient complained of increased symptoms after he returned to pulling weeds in his yard after the initial improvements. Improving the deficiencies of the deep cervical flexor muscles and strengthening of the scapular retractors correlated with the lessening of CGH in the subsequent visits. The increased deep cervical flexor strength stabilized the cervical spine, keeping the passive subsystem within the "neutral zone" and thus lessened his pain.[27] Beeton and Jull[28] conducted a randomized-controlled trial of manipulation of joints with restricted motion in conjunction with low-load strengthening of the deep cervical flexors and lower trapezius. They found that the group that received exercises for deep neck flexors strengthening along with joint manipulation showed more improvement than those who received just joint manipulation, in terms of headaches and strength.[28]

By the fourth visit, the patient's movement was restored and his headaches were no longer reproduced with testing of the restricted joints. Initially, he had decreased strength of the scapular stabilizers and tightened pectoralis muscles. This led to a posture dysfunction with rounded shoulders, and contributed to increased strain of the cervical spine. This also correlated with his history of decreased intensity and number of episodes of headaches with lifting and pulling weeds. At this point, the patient exhibited improvements in subcranial mobility and upper thoracic mobility. He also continued to progress well with regard to the strength of the local stabilizing system for the cervical spine and middle/lower trapezius. He had gained greater flexibility in his pectoralis muscles. These improvements continued to correlate with less intensity and frequency of headaches.

Those that experience CGH frequently display scapular abduction and depression. This contributes to a lengthened levator scapulae and middle/lower trapezius. This dysfunction can also lead to increased loading of the cervical spine because of the muscular connections between the cervical spine and the scapula.[23(p 160)] Posture deviation, including lumbar lordosis, can also contribute towards dysfunction of the cervical spine. Lumbar lordosis can increase thoracic kyphosis, which in turn could increase cervical loading.[29]

By the fifth and sixth visit, the patient displayed improved postural awareness and was independent in postural correction. The patient had experienced a drastic decrease in his headaches and was pain free at a follow up call a few months later. The patient had been experiencing headaches for several weeks prior to physical therapy intervention so his improvement cannot merely be attributed to rest and time.

CONCLUSION

This case report describes the intervention of manual therapy techniques in order to restore motion, neuromuscular re-education to the cervical flexors, and proper mechanics and posture to alleviate cervicogenic headaches. Manual techniques were employed for the restoration of normal motion of the upper cervical, thoracic spine, and left first rib. Stretching and strengthening contributed to the patient being able to maintain an asymptomatic posture to better support and decrease stress of the upper cervical spine. The patient was able to maintain his symptom free status up to a two month follow up because of his compliance and ability to independently maintain posture awareness and correction; thus alleviating some of the causes of CGH.

SUMMARY

The patient demonstrated improvement through the measurement of decrease in intensity and frequency of CGH, and improvement in his NDI score. The limitation of this report is that case studies focus in on one patient. This report also cannot determine long-term effects. Thus, future research should consider several patients with different CGH levels along with examining the long-term outcomes of these particular treatments. A possible approach would be to categorize the patients based on the NDI scores during the initial examination. The subjects could then be placed in different treatment groups including mobilization, mobilization and stabilization, sham manual therapy and stabilization, sham stabilization and manual therapy, stabilization, or general exercise. They can be treated for the same length of 3 to 4 weeks and the pain rating as well as the NDI can be used to measure their improvements. These outcome measures can be used every month as a follow-up for up to one year to determine the long-term effects.

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Physical Therapy Rehabilitation Following a Two-Level IDET Procedure: A Case Study

Timothy J. Bayruns, PT, DPT, OCS, CSCS[1]
Frank Angiolillo, PT, OCS, CertMDT[2]
Todd Beery, DO[3]
Christopher Plastaras, MD[4]

[1] *Musculoskeletal Team Leader, Good Sheppard Penn Partners, Philadelphia, PA*
[2] *Advanced Clinician II, Good Sheppard Penn Partners, Philadelphia, PA*
[3] *Resident, Physical Medicine, University of Pennsylvania, Philadelphia, PA*
[4] *Assistant Professor, Physical Medicine and Rehabilitation, University of Pennsylvania, Philadelphia, PA*

ABSTRACT

Study Design: Case report. **Background:** Patients may experience low back pain as a result of degenerative disc disease. One interventional technique used to treat this condition is Intradiscal Electrothermal Therapy (IDET). To date, there are no published reports exploring the role of physical therapy rehabilitation following IDET. The purpose of this paper is to describe physical therapy management of a patient who underwent a two level IDET procedure. **Case Description:** A 43-year-old female, 8 weeks following a two-level (L4-5, L5-S1) IDET procedure, completed an 8-week course of physical therapy care. The focus of treatment was on pain control, improvement in muscular stability, improvement of function, patient education, and home exercise. **Outcomes:** The patient's pain decreased from 8/10 to 0/10, function improved from an Oswestry Disability Index of 34/100 to 6/100, her trunk AROM increased from 25% to 90%, and she was able to return back to her normal job position. When contacted at 12 and 24 months post-therapy, she had no complaints and had resumed all previous activities. **Discussion:** This case report describes a postoperative physical therapy program emphasizing pain control, exercise, and educational goals following an IDET procedure. More research is needed to investigate the outcomes associated with IDET and the role of physical therapy following this procedure.

Key Words: intradiscal electrothermal therapy, physical therapy, postoperative rehabilitation, stabilization exercises

INTRODUCTION

Low back pain in the Unites States is very prevalent, with 26% of the adult population currently experiencing symptoms.[1-3] Treatment of this condition is the second most common reason for visits to a physician's office, second only to the common cold and flu.[4,5] The cost to the US economy is estimated between $75 to $90 billion a year, with expenditures increasing each year.[6-8] Although some research on low back pain[9-12] suggests that 80% to 90% of episodes will resolve within approximately 6 weeks, 5% to 10% of low back pain patients become chronic sufferers. Patients experiencing low back pain may receive physical therapy services either before or after undergoing nonsurgical or surgical intervention.[1,11]

Despite the high occurrence rate of low back pain, difficulties are well documented effectively treating this population.[9,10,12,13] Lumbar pain can originate from a number of structures such as muscle, ligament, disc, facet, and nerve root dura.[14,15] It has been estimated that low back pain originating from intervertebral disc pathology constitutes 40% of all chronic low back pain.[16] An estimated one million Americans suffer from chronic lumbar pain attributed to one or more degenerated discs.[17] Patients experiencing low back pain may follow a treatment cascade that involves a period of self-benign neglect, eventually leading to an appointment with a primary care physician if symptoms do not resolve.[18] Treatment at this stage typically includes medication, and advice to remain as active as possible. Patients who fail to obtain significant change in their symptoms are often referred for physical therapy. If approximately 6 weeks of physical therapy does not significantly decrease the level of complaints, then this can lead to consultation with a nonsurgical, then surgical, medical provider.[19]

There are several types of nonsurgical treatments that can be rendered in hopes of alleviating pain and limitations associated with diskogenic low back pain. This includes minimally invasive procedures such as epidural injections, nerve root blocks, and ablation of targeted nerves.[20] One technique that has been gaining in popularity as well as controversy is intradiskal electrothermal therapy, also known as IDET.[21]

Intradiskal electrothermal therapy was developed in 1997 by Saal and Saal,[22] as a minimally invasive treatment for diskogenic low back pain. Symptoms for diskogenic low back pain are hypothesized to be a result of (1) degeneration of the annulus, with the infiltration of nerve fibers into the disk interior,[23] (2) the nucleus causing a bulging of the disk contacting nerve or other pain sensitive structures of the spine.[24] This treatment is based on the proposed mechanism of causing a "combination of thermo-coagulation of native nociceptors and in-growing un-myelinated nerve fibers, with denaturing of annular collagen leading to a stabilization of annular fissures."[25,26] Even though some insurance carriers[27-30] consider the IDET an experimental technique, 60,000 procedures have been performed worldwide since its inception, with the average cost being $8,000.[25,26]

The IDET procedure is performed under fluoroscopy, with a 17 gauge introducer needle being placed at the symptomatic disk, and then the thermal catheter is inserted through the needle and positioned to the disk annulus.[21] A unilateral or bilateral approach can be used depending on the presenting symptoms. The catheter is then "heated from 37°C to 65°C. After the temperature has remained at 65°C for one minute and the patient has not complained of excessive pain, the temperature is increased by 1°C every 30 seconds until it is between 80 and 90°C. The actual temperature of the annular tissue is as much as 15°C lower than the temperature of the catheter tip."[21] During the heating process, the patient may experience back pain; however, the clinician must be cognoscente of radicular signs that could represent unwanted extradiskal placement of the catheter. Once the heating is completed, the needle is removed, and the disk is injected with a steroid mixed with

an antibiotic.[31] After the IDET was complete, patients are routinely placed in a hard "lumbar brace" and informed to limit their activity to only "walking." They are also instructed to follow up with an office visit in one week.

The indications for considering IDET as a treatment are "(1) axial low back pain of at least 6 months duration, (2) failure to respond to conservative treatment, (3) > 60% residual disk height, (4) positive concordant diskogram at low pressure, (5) normal neurologic exam (or at least no new deficits attributable to level to be treated), (6) negative straight leg raise, and (7) MRI results showing no evidence of root compression, tumor, or infection."[20] The contraindications include all of the above stated indications, severe disk degeneration, spinal stenosis, spondylolisthesis, or other medical conditions that could increase the risk of surgery or make follow-up care difficult."[24] The purpose of this paper is to describe physical therapy management for a patient following a two level IDET procedure.

PATIENT HISTORY

The patient was a 43-year-old female (Ms. C) who was employed as an operating room technician in a large metropolitan hospital. She sustained injury to her lumbar region as a result of a fall, whereby she landed in a seated position. Following the injury, the patient noted the immediate onset of low back pain. She presented to the occupational health center that same day, where she was examined and diagnosed with a "lumbar strain and sprain." Ms. C was prescribed pain and anti-inflammatory medication, and was not allowed to return to work. After one week of continued complaints, she was referred to physical therapy for 6 weeks of conservative care consisting of modalities for symptom control and a gradual program of exercise. She did not make any appreciable changes in her pain or level of function. The patient was then sent to interventional physical medicine and rehabilitation for consultation. Upon examination the physician determined that the patient exhibited symptoms of "internal disk derangement" and underwent several nerve root blocks over the next few months. No long-term positive results were obtained from this treatment. Diskography was performed and provocative signs were noted at two spinal segments: L4-5 and L5-S1. The patient was approved for and had two level IDET procedures at those same levels. After the procedure, the patient was given a hard lumbar brace, with instruction to take the medications, Hydrocodone and Celebrex and to continue to limit her activity level until re-examination by the attending physician.

At both the 2 week and 6 week postoperative follow-up visit, the patient still experienced low back pain, continued to use medication as prescribed, and used the brace with additional instruction to begin to increase her walking as tolerated. At 8 weeks postprocedure, the hard lumbar brace was discontinued and replaced with an elastic lumbar support with plastic stays. The patient was allowed to begin physical therapy.

EXAMINATION

Ms. C reported to outpatient physical therapy with a prescription stating "physical therapy: internal disk derangement status post IDET." Observation at the time of the initial evaluation showed the patient as being an age appropriate, medium build African American female, who displayed trunk rigidity with all active movements including gait, transfers, and sitting. During the interview, the patient noted that she was currently not working, and still following the advice and instructions of her physician. Subjective complaints were of overall weakness, decreased ability to perform normal activities of daily living, and "tingling occasionally" in the lateral and posterior aspect of her right lower extremity into her foot. Her lumbar pain ranged from a self report of 4 /10 at best to 8/10 at worst, on the numeric pain rating scale (NPRS) of '0' no pain to '10' maximum pain.[32] Ms. C reported increased complaints with activity, but symptoms were "better sitting." Her goal for rehabilitation was "to be able to work again." Her function as rated on the Oswestry Disability Index (ODI)[33,34] was a 34/100 (34%), with '0' being within normal limits (WNL), to "100" being maximally limited.

Screening of the gastrointestinal and cardiovascular systems revealed no abnormalities. Her IDET portal site was closed and well healed. Standing and sitting postural examination exhibited decreased lumbar lordosis, without evidence of a lateral shift of the spine. With active range of motion (AROM) of the lumbar spine, the patient described her movement as being approximately 25% of her normal range. Pain was experienced during all movement. As is commonly practiced across the United States,[35] this clinic visually estimated the patient's AROM, with this being determined to be a "major loss of motion."[35] Her movement about the room, and casual observation exhibited decreased and stiff trunk motion. Sensation to light touch and deep pressure in the lumbar dermatomes was WNL. Achilles and patellar reflexes were brisk and symmetrical. Manual muscle testing of the lumbar myotomes exhibited diffuse gross motor lower extremity weakness at 3/5 bilaterally in the following muscle groups: iliopsoas, quadriceps, gluteus medius, gluteus maximus, anterior tibialis, and gastrocsoleus. This finding was thought to be secondary to pain and muscle guarding. The patient had difficulty in contracting and recruiting her trunk musculature, particularly her abdominals and transverses abdominus during examination.

CLINICAL IMPRESSION

After the formal examination, the physical therapist felt the patient was exhibiting postoperative deficits as a result of continued pain, relative inactivity, decreased spinal mobility, and overall impaired function. Supportive literature on the study of Chronic Low Back Pain has suggested that this can occur due to "a series of factors."[36,37] The gross lower extremity motor weakness, difficulty maintaining muscle contraction, the patient's attempts to keep her trunk rigid, increased symptoms with trunk movement, and improved comfort in supported sitting led the examiner to hypothesize a loss of normal motor control in trunk in the subject. This is consistent with her complaints and reporting in the ODI. Despite this, the therapist felt that the patient's emotional status was positive, with her perception being that the worst was behind her, and that the rehabilitation process would yield good results.

The examination findings and clinical impressions were discussed with the patient. A plan of care was agreed upon to address the identified deficits. The rehabilitation sessions were set at 3 times a week, with full attendance and compliance being stressed.

The short- and long-term goals were identified as the following:

Short-term goals (within approximately 12 sessions):

1. Reduce maximal pain to 4/10.
2. Decrease ODI scale to 15/100.
3. Improve lumbar AROM to moderate loss of motion.
4. Increase her level of activities of daily living.

5. Patient to be independent in home exercises.
6. Increase her lower extremity strength to 4+/5 in the identified deficit muscle groups.
7. Improve and be able to demonstrate better trunk motor control as evidenced by an ability to maintain contraction of the transversus abdominis during all activities.

Long-term goals (approximately 24 sessions):

1. Reduce maximal pain to 1/10.
2. Decreased ODI scale to 10/100.
3. Improve lumbar AROM to minimal loss of motion.
4. Perform activities of daily living with no limitations.
5. Return to full/normal work routine.
6. Patient to be independent in home exercises.
7. Lower extremity strength to 5-/5 in the identified deficit muscle groups.

Physical Therapy Intervention

The plan of care for the patient can be divided into 3 phases:

1. Pain control and patient education
2. Return of neuromuscular control
3. Resumption of activities of daily living including return to work

Phase 1 (weeks 1 and 2, and part of 3): During the initial phase of the patient's rehabilitation program, pain control was stressed to allow recovery of trunk motor control and initiate strengthening exercises. This part of her care included use of modalities of moist heat[38,39] and transcutaneous electric nerve stimulation (TENS).[18] These modalities were implemented because of the patient's past experience in preoperative physical therapy, as well as the literature suggesting benefits of muscle relaxation and pain control.[40,41] The added benefit of providing Ms. C with the means to successfully self-treat her pain (by adjusting the intensity of the TENS unit) was also considered. It was thought that if the patient were more comfortable, then she would be more willing to engage in exercise.

Education was also considered an important aspect of low back rehabilitation,[42,43] with data suggesting that, in combination with exercise, it is more effective than exercise alone. Education took the form of session based information given by the treating physical therapist along with the facilities "Back School Program," which consisted of an hour long Power Point presentation and handout of the lecture material. Ms. C was also educated on the healing process of tissue and the process of pain reduction following IDET. Research[21] indicates that after an IDET procedure pain reduction may take up to 12 weeks because the "healing process reaches its peak" at approximately the 4-month mark. The concept of a graduated progression in the therapeutic exercise program, and recovery of independence in ADL was discussed in detail with the patient.

Initial therapeutic exercise included instruction in proper activation of the transverse abdominus and multifidus muscles. The concept of maintenance of tone throughout any activity was stressed. This started out with the patient being able to successfully perform this in the supine position, with gradual addition of lower extremity hip flexion, and hip flexion with upper extremity movement. Significant progress in the achievement of muscle control was noted; however, before she could be progressed to the next phase, Ms. C came down with the flu and cancelled the last session of week two. Treatment resumed the following week, with a marked increase of pain (7/10) and a worsening of her Oswestry score (44/100), which the patient attributed to the systemic illness.

Phase 2 (part of week 3 to week 5). Once the patient was able to independently demonstrate activation and muscular control of the transverses abdominus in supine, she was progressed to exercises in prone: first involving unilateral movements, then bilateral motion, and finally combination movements of the upper and lower extremities. Treatment progressed to motor control exercises in kneeling using the same progression, followed by standing, and finally with dynamic motion patterns on various surfaces. Specifically these dynamic activities included sitting on a therapy ball, standing/kneeling on Dyna Discs, and using light hand held weights. Successful performance in this phase led to the introduction and use of mechanical isotonic exercise and cardiovascular equipment. Research has demonstrated that this progression can enhance the activities of the trunk muscles.[44]

Throughout this phase a significant decrease in pain, with corresponding increase in AROM and function was noted (refer to Table 1: week 3 to 5). Ms. C discontinued the use of the TENS at the end of this phase secondary to the improvement of her overall condition. In addition to her expanding therapy program, she was progressed in her home exercises, and encouraged to "do any activity that you are comfortable doing at home." Her short-term goals were achieved.

Phase 3 (6 to 8 weeks). The last phase was a progressive increase in her therapy gym program by adding more generalized strengthening and cardiovascular activities including work simulation tasks of carrying 'OR trays' starting out with 5 lbs and gradually increasing to 15 lbs, using both unilateral and bilateral upper extremities. By this time in her rehabilitation process, the patient was spending up to an hour and a half performing almost continuous exercise activities.

At the start of the 7th week, the 18th session (refer to table), Ms. C came to the clinic reporting that "my niece ran into my right leg, and my knee blew up." Clinical examination revealed positive valgus pain, and pain with palpation of her medial collateral ligament, and her medial hamstring insertions. Her program was scaled back that day and the next with no isotonic exercises being performed, with the patient given cold modalities applied to her knee. Following a phone consultation with the referring physician, a decision to have the treating physical therapist manage these signs and symptoms was made. Cold modalities and program modification were used, with the patient's symptoms resolving quickly. At the end of that week, the patient felt "94% there" and felt she could return back to work.

An attempt to communicate with the patient's work supervisor was made; unfortunately, the supervisor was unavailable until the following week and the patient was not permitted to return to work without this clearance (refer to table, week 7). It was decided to continue the rehabilitation program until contact with her supervisor was made. Ms. C left after the 22nd session (mid week 8) expecting her to return for visit 23. She called the next day and informed the therapist that she had met with her supervisor, and was going to start back to work the day after the phone call. All of her goals for her physical therapy program were obtained, and she was discharged from further care.

OUTCOME

Prior to IDET procedure, Ms. C had failed conservative care, and was not responsive to a series of nerve root blocks, continuing to have pain, limitations, and not able to work. After the IDET, she continued to

Table 1. Patient Data

	Week 1 Visits: 1-3	Week 2* Visits: 4-5	Week 3 Visits: 6-8	Week 4 Visits: 9-10	Week 5 Visits: 12-14	Week 6 Visits: 15-17	Week 7 Visits: 18-20***	Week 8 Visits: 21-22
Work Status	Not working						Attempted to return to work	Return to regular duty
Maximal Pain (NPR)	8/10	7/10	6/10	5/10	3/10	3/10	0/10	0/10
Function (Oswestry)	34/100		44/100**	22/100	20/100		6/100	6/100
Lumbar AROM	Major loss		Moderate loss				Minimal loss	Minimal loss
Lower Extremity Strength	3/5		4-/5		4+/5		5-/5	5-/5

* indicates missing one session due to the'flu'
** as result of the 'flu'
*** indicates right knee injury

experience all this, but was looking forward to the upcoming rehabilitation program. At the start of physical therapy her NPRS was an 8/10, ODI was 34/100, with a major loss of normal lumbar AROM, weakness in her lower extremities demonstrated to be 3/5; all this required her to be out of work. By week 3, even though there was a temporary increase in her ODI to 44/100 as a result of a bout with the flu, she was still able to have her pain drop to a maximum of 6/10, with a moderate loss her AROM, with an increase in her lower extremity strength to 4-/5. Once she had fully recovered from the flu by the end of week 4, her NPRS dropped to a 5/10, and her function improved to an ODI of 22/100. The subject continued improving into week 5 by having her NPRS registered as a 3/10, her ODI at a 20/100, and lower extremity strength 4+/5. When week 7 ended, she was experiencing no pain, her ODI at a 6/100, a minimal loss of lumbar AROM , and her lower extremity strength at 5-/5. The patient returned to work full duty status at the end of week 8 of her physical therapy program with all goals obtained.

DISCUSSION

To the authors' knowledge, this is the only paper in the physical therapy literature to date to discuss the role of physical therapy rehabilitation following a two level IDET. The information presented in this manuscript, though not definitive, suggests that if given the proper education, strengthening exercises, and guidance, patients experiencing pain, decreased function, decreased range of motion, and decreased strength can improve these deficits and return back to work in an efficient time frame. This patient was able, following an 8-week rehabilitation program, to become pain free and return to all pre-onset activities. Six months, 12 months, and 24 months following her rehabilitation, she remained fully functional and employed.

LIMITATIONS

As a case report, this paper has its limitations. No formal means of exploring the subject's psychological state by means of the use of such tools as the Fear Avoidance Belief Questionnaire[45] was undertaken. Another methodological weakness was not using a more formal quantitative AROM device, such as an inclinometer. The positive results of the rehabilitation program cannot be used as definitive proof that this is the most efficient method of care. More rigorous study is needed. Our paper may serve as a guide in setting realistic goals for patients having undergone the IDET procedure.

CONCLUSION

The IDET procedure has been used throughout the world to treat axial low back pain and decreased function as a result of Degenerative Disc Disease but only recently has been employed as a procedure in the United States. Low back pain and deficits in strength, active range of motion, and function can still be present after this type of surgical intervention This case report suggests that patient education and a progressive supervised exercise program can achieve pain reduction, increase trunk and lower extremity motor control, and may lead to a reasonable return to pre-onset functional levels for a patient who has undergone the IDET procedure.

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Proprioceptive and Strength Deficits of the Lower Leg Following Achilles Tendon Rupture and Repair

Jonathan Gallas, PT, DPT, CSCS

Accelerated Rehabilitation Centers, Belvidere, IL

ABSTRACT

Background and Purpose: Achilles tendon rupture is an injury that typically occurs in patients in their 30s and 40s.[1] Males tend to be more affected than females.[1] The purpose of this retrospective case study is to describe a patient that appears to have sensory, proprioceptive and strength deficits as a complication of Achilles tendon rupture and repair. **Case Description:** The patient is a 39-year-old male who weighs 175 lb and is employed as an ironworker. He initially suffered a partial right Achilles tendon tear and a subsequent full rupture and repair. **Interventions:** The rehabilitation focused on gastrocnemius and soleus strengthening and static and dynamic balance training on various surfaces. **Outcomes:** Outcomes were assessed for strength and range of motion measurements and also through administration of the Ankle Joint Functional Assessment Tool (AJFAT). The patient demonstrated improvements in right gastrocnemius and soleus strength and static and dynamic balance. **Clinical Relevance:** This case study demonstrates that sensation and proprioceptive deficits may occur following Achilles tendon ruptures as a consequence of trauma or nerve compression injuries.

Key Words: Achilles tendon rupture, proprioception, sensory neuropathy, gastrocnemius, soleus

BACKGROUND

Achilles tendon rupture is an injury that typically occurs in patients in their 30s and 40s.[1] Males tend to be more affected than females.[1] The Achilles tendon attaches from the calcaneus to the gastrocnemius and soleus muscles.[2] The most common mechanisms of injury include sudden forceful plantarflexion of the ankle, unexpected forceful dorsiflexion, and an extremely forceful dorsiflexion.[1] Rupture of the Achilles tendon results in a complete tearing of the tendon typically 3 to 6 centimeters proximal to the calcaneus.[3]

Even though muscle tear occur, they may result in damage to nerve tissue. Nerve injuries occur because of various mechanisms; most commonly ischemia, compression, traction, and laceration.[4] Wall et al[5] found that only a 6% strain for 60 minutes may result in loss of nerve function. The purpose of this case study is to describe a retrospective case study of a patient that presents with sensory, proprioceptive, and strength deficits as a complication of Achilles tendon rupture and surgical repair.

CASE DESCRIPTION

History

The patient is male who is a 39-year-old ironworker weighing approximately 175 pounds who suffered a partially torn right Achilles tendon when he stepped in a hole on a jobsite. The patient was referred to the author for physical therapy treatment 15 months following his initial injury of his partially torn right Achilles tendon and also following subsequent repair for a complete rupture of the right Achilles tendon.

At the time of initial injury, the patient experienced pain in the area of apparent injury. A magnetic resonance imaging (MRI) revealed that the patient had a 66% tear of his right Achilles tendon near its attachment at the calcaneus. The patient was immobilized in a plaster cast for 8 weeks. The patient experienced mild numbness on top of his right foot while in the cast and after it was removed. It was determined by the patient's physician and through MRI that the Achilles tendon was not completely healed. The patient then underwent 8 weeks of physical therapy. The authors are not aware what types of activities were performed or what the outcomes were following this 8 weeks of physical therapy. It is clear that the patient was unable to ambulate with 10° of dorsiflexion in his right ankle, and he was not able to perform a single heel raise on his right lower extremity. At the end of the 8 weeks, the patient was told by his physician that he could no longer do anything else for him unless he totally ruptured his right Achilles tendon. The patient returned to his regular job and duties as an ironworker. It is unknown what the patient's outcomes were from this first 8 weeks of physical therapy since these services were provided by a different physical therapist and at a different location than where this case study was performed.

Over the next 7 months, the patient had 3 cortisone injections 2 to 3 months apart for pain relief in his right Achilles tendon. Following the injections, the patient completely tore his right Achilles tendon 7 months after the initial tear while walking on the jobsite as an ironworker. The patient had his right Achilles tendon surgically repaired by a different orthopaedic surgeon familiar with Achilles tendon repairs. The patient spent 2 weeks in a partial plaster cast in 20° of plantarflexion, and one week in a walking splint before presenting to physical therapy. The patient noted numbness on top of his right foot following removal of the cast. This numbness was similar to previously experienced numbness in his right foot but extended to his lateral foot and ankle. Following surgical repair the patient participated in a 15 week physical therapy program including flexibility, strengthening, and endurance exercises for his right gastroc soleus complex.

Work Conditioning Program

After 15 weeks, the patient was discharged from physical therapy to work conditioning due to a plateau in progress in physical therapy. Following physical therapy, the patient was still ambulating slowly with limited dorsiflexion in his right ankle. The patient was not able to perform a single heel raise with his right lower extremity due to limited ankle plantarflexion and inversion strength. The patient demonstrated difficulty negotiating stairs and squatting to the floor. Sensation of his right lower extremity was not assessed specifically at this time. The patient did report numbness on the top of his foot, but was told that he would have some numbness following the surgery. For the next 8 weeks, the patient worked out 2 to 3 hours 5 times per week in work conditioning.

During the supervised work conditioning program, the patient participated in several activities designed to strengthen, increase range of motion, and increase muscle endurance of his right gastroc-soleus complex. Additional goals included maintaining cardiovascular fitness. Cybex 6000 (CSMI Medical Solutions, Stoughton, MA) tests were performed during work conditioning (Table 1). Following work conditioning, the patient's physician wrote an order for a home neuromuscular electrical stimulation unit and to continue work conditioning for another 6 weeks. Both requests were denied by workers compensation, and the patient was discharged from physical therapy.

INITIAL EVALUATION AND BEGINNING OF CASE REPORT EXAMINATION

Upon initial physical therapy evaluation 15 months following initial injury, the patient's chief complaints were right ankle weakness, instability, and right medial knee pain. The patient was referred to physical therapy after a new calendar year of benefits for 4 weeks for continued strengthening to his right calf. The patient's physician felt that his continued right calf atrophy was due to weakness, and worker's compensation agreed to a second session of physical therapy following surgery. This point in time is when contact with the patient began and the case study examination took place.

The patient identified that prior to his first injury to his right Achilles tendon, the patient was running 5 miles a day and playing recreational basketball. The patient also enjoyed hunting and trap shooting. The patient's desired outcomes/goals were to return to full-time work as an ironworker, ambulate independently on uneven surfaces, play with his children in the yard, jog for recreation, climb ladders, and ambulate on narrow beams.

Examination (includes data from initial evaluation by author 15 months following initial injury and re-evaluation by author at 10 months and 13 months following his initial evaluation)

Pain

Pain was assessed using a verbal 0-10 pain scale (0/10 was considered no pain and 10/10 was considered emergency room pain). Upon initial evaluation by the author, the patient described his pain as 3/10 at rest and 5-6/10 when walking, sharp in nature, and located at the most superior part of his incision.

At re-evaluation by the author 10 months following the initial evaluation, the patient had no complaints of pain at rest and 3/10 described as sharp and burning pain at the superior most aspect of his incision when walking. At 13 months re-evaluation, the patient reported 8-9/10 pain daily lasting 2 to 3 seconds and sharp in nature when he took his work boots off and began to relax. The pain was located in the patient's arch and posterior right heel.

Gait

The patient ambulated with a right antalgic gait pattern and increased valgus at his right knee at toe off on his right lower extremity. The patient demonstrated decreased step and stride length on his left lower extremity compared to his right lower extremity. At 10 month re-evaluation, the patient continued to demonstrate increased valgus at his right knee but less than at initial evaluation.

Range of Motion

Initial evaluation range of motion measurements were taken using a standard goniometer. The goniometer was parallel with the patient's lateral malleolus with the long arm of the goniometer pointing towards the patient's fifth metatarsal bone, and the reference arm pointing at the patient's fibular head.[6] Reliability values for foot and ankle ROM have been previously demonstrated in 3 studies by Boone et al,[7] Elveru et al,[8] and Shields et al.[9] Range of motion results obtained at initial evaluation are found in Table 2. Range of motion results at 10 month re-evaluation following initial evaluation (25 months after injury) can be obtained in Table 3.

Muscle Strength

Manual muscle testing of the right ankle dorsiflexion and plantarflexion was 4+/5. Manual muscle testing for right ankle eversion was 4+/5, and for right ankle inversion was 5/5. The testing was performed in supine. The patient was unable to perform a double heel raise.

At 10 month re-evaluation, strength of the right ankle as measured by manual muscle testing was 4+/5 for all movements, except the ankle inverters which were 5/5. The patient was able to perform a double heel raise and raise his right heel 1 cm off of the floor. The patient was unable to perform a single heel raise on the right.

At his 13 month re-evaluation, the patient was able to perform a double heel raise and raise his right heel off of the ground 4 cm. The patient was able to also perform a single heel raise on the right raising his heel

Table 1. Cybex 6000 Testing Results (% deficits compared to left ankle:inv/uninv *100)

	During Initial Physical Therapy 60°/sec (not performed by author)	During Work Conditioning 30°/sec (not performed by author)	At Reassessment 30°/sec, 90°/sec, and 240°/sec (performed by author)
Dorsiflexion Peak Torque	48%	12%	WNL
Dorsiflexion Total Work	45%	6%	WNL
Plantarflexion Peak Torque	80%	36%	44%, 39%, 15%
Plantarflexion Total Work	57%	18%	48%, 31%, 24%

4 cm off the ground.

Biodex testing was performed in a sitting position with the patient's right foot strapped to a footplate. Results indicated no strength deficit in dorsiflexion, a 44% deficit in plantarflexion strength, and 48% deficit in plantarflexion power at 30°/sec.

Further testing at different speeds revealed no deficit in dorsiflexion, a 39% plantarflexion strength deficit, and 31% plantarflexion power deficit at 90°/sec. Final testing revealed no strength deficit in dorsiflexion, a 15% plantarflexion strength deficit; and 24% plantarflexion power deficit 240°/sec (see Table 1). Shields et al[9] noted an average loss of plantarflexion strength of 16.5% at 30°/sec and a 17.5% average deficit in plantarflexion power at 120°/sec on a surgically repaired Achilles tendon. Previous Cybex testing was done at similar speeds on 101 subjects following closed Achilles tendon rupture and repair by Leppilahti et al[10] that noted an average decrease in plantarflexion strength of 3% to 9% in men and 6.4% to 16.6% in women at speeds of 30, 90, and 240°/sec.

Palpation

Palpation of the patient's right Achilles tendon indicated a slightly raised scar about 5 inches length along the patient's Achilles tendon. Dense scar tissue was noted about 2 cm on each side of the patient's Achilles tendon along the length of the scar. No edema was noted surrounding the patient's Achilles tendon or in his joint. No tenderness was noted at this time. At 13 month re-evaluation, scar mobility was normal. Mild to moderate laxity was noted in the patient's right MCL of the knee with a valgus stress test at 0° and 30° of knee flexion.

Assessment of accessory motions/joint glides of the subtalar joint

The patient demonstrated decreased medial calcaneal or subtalar joint (STJ) glide. At 10 month re-evaluation, mild hypomobility was noted with right ankle medial subtalar joint calcaneal glide. At 13 month re-evaluation, normal accessory motion was noted in the patient's right ankle.

Girth Measurement

No girth measurements were taken at initial evaluation. At 10 month re-evaluation, girth measurements were taken of both gastrocnemius muscles. Measurements were taken 14 cm below the inferior pole of the patella. Measurements indicated 4 cm of atrophy in the patient's right gastrocnemius muscle. At 13 month re-evaluation, 3 cm of right gastrocnemius muscle atrophy was noted.

NEUROLOGICAL EXAM

Balance

At initial evaluation, the patient was asked to stand on a regular hard surface and a 2 inch foam mat with his feet together and eyes closed (Rhomberg position) and in a heel-toe position with his eyes closed (Tandem or Sharpened Rhomberg position). Franchignoni et al[11] reports inter-rater reliability of the Sharpened Rhomberg position to be .99. Ritchie et al noted reliability of the tandem position to be .52. Reliability was established by Ritchie et al[12] for the parallel test (feet together) to be .95. Inter-rater reliability reported for the single leg stance (SLS) test was .99 with eyes open and .75 with eyes closed.[11]

The patient was able to stand in the Rhomberg position for 10 seconds. The patient was unable to stand in the right Sharpened Rhomberg position. The patient was able to correct himself for loss of balance. At 10 month re-evaluation, balance testing revealed the following results: SLS time-10 seconds, Rhomberg-30 seconds, Tandem-3 seconds. All tests were performed on a stable surface with eyes opened for SLS and eyes closed for Rhomberg. On a foam surface the patient experienced a loss of balance in less than 10 seconds with eyes opened. The patient experienced a loss of balance to the right with tandem walking at 10 steps with eyes opened. At 13 month re-evaluation, the patient was able to hold the Rhomberg position for over 2 minutes on a stable surface. The patient was able to sustain a right tandem position on a stable surface for 60 seconds, a foam surface for 6 seconds, a right SLS position on a stable surface for 25 seconds, and on a foam surface for 15 seconds. The patient was able to perform left and right carioca without loss of balance. The patient was able to perform a tandem walk with loss of balance to the right after 40 steps.

Sensation and Proprioception

All sensation testing for peripheral nerves was initially assessed at 10 month re-evaluation. The patient demonstrated decreased light touch and sharp dull sensation in the L4, L5, and S1 distributions. The areas of decreased sensation included: medial gastrocnemius, 5th metatarsal, anterolateral ankle, and dorsum of the right foot. The nerve root levels supplied by the sural nerve include L4-S3. The superficial peroneal nerve is supplied by L5-S2, and the saphenous nerve is supplied by L2-L4.

Due to the results indicating impaired sensation, an EMG was requested. The results of the EMG concluded that there was sensory impairment of the superficial peroneal, sural, and saphenous nerves of the right lower extremity. The sural nerve is a sensory nerve supplying the lateral foot and ankle.[13]

The sural nerve forms approximately 11 to 20 cm above the lateral malleolus.[14] An injury to the sural nerve following a percutaneous repair of the Achilles tendon may occur because of its close proximity to the lateral border of the Achilles tendon.[15]

Table 2. ROM at Initial Evaluation by Author 15 Months After Injury

	AROM-Right	PROM-Right	AROM-Left	PROM-Left
Dorsiflexion	12°	18°	10°	WNL
Plantarflexion	50°	62°	48°	WNL
Inversion	25°	30°	40°	WNL
Eversion	10°	15°	8°	WNL

Table 3. ROM at Re-evaluation by Author 10 Months after Initial Evaluation (25 months after initial injury)

	AROM-Right	PROM-Right	AROM-Left	PROM-Left
Dorsiflexion	15°	20°	12°	18°
Plantarflexion	61	66°	61°	66°
Inversion	45	45°	40°	45°
Eversion	12	18°	15°	20°

Saphenous nerve injuries account for less than 1% of all lower extremity injuries.[16] Injury to the superficial peroneal nerve has been determined to occur with as little as a 6% greater stretch when compared to its resting length.[17]

Further sensation testing included light touch, sharp/dull, two-point discrimination, vibration, hot/cold, and proprioception. Light touch was performed by the therapist who swiped the patient with the tip of his finger while the patient's eyes were closed. Sharp/dull sensation was performed with the sharp edge and dull edge of a paper clip in the same manner. Proprioceptive testing also was impaired. In addition, static and dynamic balance testing was performed revealing impairments. A follow-up strength test on the Biodex was performed revealing plantarflexion strength deficits of the right ankle.

All hot and cold testing was within normal limits for the superficial peroneal, sural, and saphenous nerves. Vibration testing was performed by placing the tip of a 120 Hz tuning fork on medial and lateral malleoli, fibular head, and base of the fifth metatarsal. The patient was able to feel the vibration sensation in all 4 of the bony landmarks on the right foot and ankle; however, he noted that the vibration sensation was significantly less than the left foot and ankle. Light touch was performed with monofilaments 4.56, 4.31, 3.61, and 2.83. Sensory impairments are shown in Table 4.

DIAGNOSIS

Diagnosis was made according to the *Guide to Physical Therapist Practice Practice* Patterns 5F- Impaired Peripheral Nerve Integrity and Muscle Performance Associated with Peripheral Nerve Injury and 4D Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated with Connective Tissue Dysfunction.[18]

PROGNOSIS

It has been hypothesized that nerves regenerate at approximately 1 to 7 mm per day.[4] Length of recovery will depend on the extent of the peripheral nerve damage and if motor damage is present, as well as sensory damage.

GOALS

Anticipated goals for this patient at initial evaluation included return to regular job duties of climbing ladders, walking on high beams, operating a clutch in a motor vehicle, return to regular jogging, and walking on uneven sandy or grassy surfaces without loss of balance or instability in his right ankle and foot. Other goals include returning to hunting and playing with his children in the yard.

INTERVENTION

Based on the initial evaluation data, the patient was performing a home exercise program consisting of: stationary biking, treadmill walking, Stairmaster climbing, and elliptical training. The patient began each of these cardiovascular activities for 10 minutes and progressed to 20 minutes with each.

Van Deursen et al[19] state that balance deficits are common following neuropathy and often results in deficits in both static and dynamic postural stability. Bernier et al[20] noted that 6 weeks of balance and coordination training improved postural control and proprioception in patients with unstable ankles. Rozzi et al[21] concluded that balance training in the SLS position for 4 weeks was enough to improve balance and proprioception in patients with unstable ankles.

The patient practiced high-level static and dynamic balance activities such as Rhomberg, tandem, SLS, and tandem walking on various surfaces such as foam and hardwood floor to increase strength and proprioception of this patient's right ankle and foot. All exercises are performed without shoes and/or socks to increase proprioceptive feedback to the tissues of the right ankle and foot.

The Rhomberg exercise was performed repetitively for approximately 3 to 5 minutes on a stable hardwood surface and a blue foam mat 2 inches thick, 3 feet long, and 2 feet wide. The patient was instructed to hold each exercise position until he lost his balance and then rest 30 seconds. The tandem and single leg stance exercises were performed on the same surfaces for the same amount of time with the same amount of rest between repetitions. These interventions were performed daily for 4 weeks following initial evaluation.

Interventions at 10 and 13 months following the initial evaluation included: daily walking outdoors for 30 minutes and static and dynamic balance exercises described previously. The patient was also working on right gastrocnemius strengthening by concentrating on double heel raises and single heel raises. The patient occasionally used his home electrical stimulation unit (obtained during his second bout of physical therapy following surgery and after work conditioning) while walking or performing his gastrocnemius strengthening exercises. The unit was set up for neuromuscular stimula-

Table 4. Summary of Sensation Testing at Re-evaluation by Author 10 Months Following Initial Evaluation

	Light Touch	Two-Point Discrimination	Sharp /Dull
Superficial Peroneal Nerve	Impaired to mono-filament 4.31 and 3.61, hypersensitivity at 1st MTP	Impaired to 20 mm from the point where the superficial peroneal nerve surfaces all the way down to its terminal branches, impaired to 60 mm 7 mm medial and superior to the lateral malleolus	Impaired along the entire distribution of the nerve, impaired 7 cm superior and medial to the lateral malleolus down to the base of the DIP joints of all fives toes. Impaired along the entire distribution of
Sural Nerve	Impaired to mono-filaments 4.56 and 3.61	Impaired to 30 mm 13 cm proximal to the calcaneus, impaired to 20 mm along the rest of the sural nerve down to the lateral surface of the PIP joint of the 5th toe	Impaired along the entire distribution of the nerve, impairment from 13 cm proximal to the calcaneus down to the lateral surface of the PIP joint of the 5th toe.
Saphenous Nerve	Impaired to mono-filament 2.83 at at Hunter's Canal	Impaired to 20 mm at Hunter's Canal	Intact throughout the superficial aspect of the saphenous nerve

tion with 10 seconds of on time followed by 10 seconds of off time. The intensity of the unit was increased to the highest intensity that the patient could tolerate. Four surface electrodes were placed on the patient's right gastrocnemius.

OUTCOMES

No functional assessment tools were administered at initial evaluation. Outcomes were determined at 10 and 13 month re-evaluations by using the Ankle Joint Functional Assessment Tool (AJFAT). The AJFAT measures a person's overall perceived level of function. The overall score is determined out of 48 points. Greater scores represent higher overall levels of functional ability of the involved ankle.[21] At the 10 month re-evaluation, the patient scored 12/48 on the AJFAT. At the 13 month re-evaluation, the patient scored a 13/48 on the AJFAT.

DISCUSSION

The sural nerve is at risk for injury during Achilles tendon rupture and repair because of its close proximity to the Achilles tendon.[4] The sural nerve may be injured from the initial trauma leading to stretching of the nerve beyond its elastic capabilities, during surgical repair of the Achilles tendon, or from compression due to casting following surgical repair.[4,22]

Little research discusses or implicates sensation deficits from sural nerve damage as a consequence of Achilles tendon rupture. Bressel et al[23] discussed proprioceptive changes following Achilles tendon rupture and concluded that bilateral proprioceptive changes were present following Achilles tendon rupture. This case study is unique due to the sensation changes in this patient's right foot, ankle, and lower leg. The prolonged gastrocnemius and soleus weakness appears appropriate considering the length of time that the patient continued working as an ironworker on his right ankle and foot prior to the repair and his history of cortisone shots prior to surgical repair of the torn Achilles tendon.

While the sensation changes in the right foot may be related to compression or rapid stretching of the sural and superficial peroneal nerves, the loss of vibration and proprioception seem to be related to the sensory changes that have occurred due to the damage to peripheral nerves.

It is likely that the sensory damage to the superficial peroneal nerve occurred from compression to the nerve when the patient was casted after the initial tear or after surgical repair of his Achilles tendon. This is supported by the fact that the patient recalled numbness on top of his right foot after both casts were removed.

The saphenous neuropathy may have been related to nerve compression due to compensatory gait due to right gastrocnemius and soleus weakness leading to increased eversion of the right ankle and increased knee valgus stress. It is also possible that the medial cutaneous branch of the saphenous nerve was compressed with casting leading to the sensation changes in this patient's right foot and ankle. It is important that the health care professional screen for sensation changes in the lower leg and foot following trauma or casting to this area. It is clear that peripheral nerves may be disrupted leading to neuropathies or sensation changes resulting in balance and proprioceptive deficits. This is important for the health care professional to integrate static and dynamic balance and proprioceptive drills into the rehabilitation program for the patient in order to help him fully recover from injury and be ready to return to ADLs, sports, or work activities that may require higher level balance activities. It is also important to realize that if a long period of time has passed from injury to repair, strength rehabilitation of the gastrocnemius and soleus muscles will require more time leading to an alternate rehabilitation protocol.

Future studies should include sensation, vibration, and proprioceptive testing prior to and following removal of a cast after repair of the ruptured Achilles tendon. Proprioceptive and balance training should be included in the protocol as soon as full weight bearing is allowed.

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Thrust Joint Manipulation Skills Development for Physical Therapists: A Laboratory Course

This course is designed to maximize physical therapists' ability to successfully modify manipulation techniques to produce the best results. These techniques will focus on operator stance, posture, handling, patient positioning, operator positioning and modifying factors. Treatment techniques use component techniques by applying multidirectional forces to apply a "focusing" technique rather than locking. This course will be primarily dedicated to hands on/lab practice. Guided discussions will provide for rationale, indications, contraindications of manipulation and risks.

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This one-day hands on laboratory based course will focus on the use of mobilization and manipulation techniques that can be incorporated into the plan of care of individuals who have had extensive trauma to the foot and ankle as well as those individuals with chronic, overuse conditions. The morning session will initially focus on the current evidence to support the use of the manual therapy techniques to be presented, followed by hands on laboratory experiences. The afternoon sessions will focus on case studies to integrate the manual therapy concepts and techniques presented in the morning session. In addition, a discussion and practice session on the use of mobilization of movement will also occur in the afternoon session. Best available evidence will be integrated into all discussion and laboratory sessions. The intent of this course is to provide attendees with useful, clinically relevant information that can be immediately applied into various practice settings.

Sonography for Common Lower Extremity Orthopaedic & Sports Conditions

Sonography is fast becoming an adjunct to physical therapist management of orthopaedic and sports conditions from professional athletes and Olympians to outpatient clinics with a general orthopaedic patient population. This course will present the physical therapy application of musculoskeletal sonography for common hip, knee and ankle conditions. The course will provide an overview of the physics of sonography. Techniques of imaging the lower extremity will be presented. Identification of normal anatomy and abnormal morphology will be presented. The indications for, and limitations of, sonography and other imaging modalities in musculoskeletal conditions will be discussed. Participants will apply techniques learned using hands-on sessions with live demonstrations and practice sessions. The practical aspects of incorporating sonography into PT practice will be presented.

Evaluation, Conservative Intervention, and Post-Surgical Rehabilitation for Individuals with Non-Arthritic Hip Pain

Diagnosis and treatment of individuals with non-arthritic hip related pathology can be difficult secondary to the close interrelationship between the lumbopelvic complex, soft tissue structures, and the hip joint itself. This lab intensive course will outline an evaluation algorithm to assist with the differential diagnosis process for pathologies associated with the hip region. These specific evaluation techniques will allow for a classification-based treatment program and include hands-on mobilization techniques and innovative exercises. Essential diagnostic imaging techniques, including radiographs, magnetic resonance imaging arthrogram, and diagnostic injections, will be integrated into the evaluation process. Arthroscopic surgical procedures and techniques for post-surgical rehabilitation will also be discussed. This unique course will offer the teaching expertise of an orthopaedic surgeon who specializes in hip arthroscopy. Additionally, this hands-on course will allow clinicians to implement evaluation and treatment techniques into their practice. Concerns for the rehabilitation of athletes with sport-specific considerations will also be reviewed and include clinical pearls and perils to help improve patient outcomes.

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Should Dry Needling for Myofascial Pain be Within the Scope of Practice for Physical Therapists?

Sinéad A. FitzGibbon, PT, MS

Doctoral Student, graduate program in Orthopedic and Sports Physical Therapy, Rocky Mountain University of Health Professions, Provo, UT & Co-owner Manual and Sports Physical Therapy, Sag Harbor, NY

INTRODUCTION

Health care expenditure in the United States reached $2.2 trillion in 2007, increasing 6.2% from the previous year, and amounted to 16.2 % of the gross domestic product.[1] Professional services, including physical therapy, accounted for $62 billion of this cost.[1] Myofascial pain is one of the leading complaints of patients presenting in general medical practice, with reported prevalence of 20% to 93% in general practice[2,3] thus imposing significant financial burdens on state and national health care budgets.[3] With high prevalence and associated costs, there is unrelenting pressure on insurers, clinicians, and researchers to reduce costs while optimizing outcomes. The physical therapy profession is at the forefront of cost containment by promoting comparisons of the effectiveness of different interventions in management of musculoskeletal pain.[4] Physical therapists use nonsurgical, nonpharmaceutical modalities in the prevention and treatment of disability.[5] Moreover, the 2020 vision statement of the American Physical Therapy Association (APTA) reflects the emerging priorities of the profession by emphasizing the provision of expert care using evidence-based practice.[6] With 44 states allowing direct access to physical therapists (PTs) at a lower cost than physical therapy via physician referral,[7] PTs are a part of the vanguard of cost containment in health care.

Physiotherapists began musculoskeletal care in 1894 as a group of nurses practicing remedial massage in the United Kingdom (UK), and evolved into established professional organizations on both sides of the Atlantic. Today there are 170,000 practicing PTs in the United States and 36,000 chartered physiotherapists in the United Kingdom, with therapists recognized as expert clinicians in management of musculoskeletal and myofascial pain.[8,9]

Physiotherapists practicing internationally in the United Kingdom, Australia, New Zealand, and throughout Europe use dry needling alongside traditional modalities in management of myofascial pain.[10-12] The multimodal, direct access practice model is beneficial to both the consumer and the clinical practitioner, as well as cost effective for all involved parties.[7] There are growing numbers of national and international courses in dry needling for physical therapists,[13-15] with 5,500 physiotherapists in the UK[16] and over a thousand such therapists in Australia[17] now licensed to use needling in physical therapy practice.

Direct access to physical therapy gives patients suffering from myofascial pain a gateway into a broad spectrum of pain management techniques. Physical therapy professionals are expert first-line clinicians in delivery of pain management modalities. With inclusion of dry needling in the battery of techniques available to skilled clinicians, cost-effective nonsurgical pain management options could improve patient outcomes and contribute to containing health care costs. In order to understand how dry needling by physical therapists can enhance pain management, knowledge of its history and current use is warranted. This paper will outline the background of the trigger point theory and describe dry needling as used in management of myofascial pain. It will then compare and contrast the educational processes of acupuncturists and physical therapists with regard to use of needling. Finally, the case will be made for broadening the physical therapist's scope of practice to include dry needling, with special reference to use of evidence-based practice in the current fiscally challenging medical environment.

DRY NEEDLING: BACKGROUND

Dry needling, generally understood as the insertion of filiform (fine filament) needles without use of saline or other liquid substances, has its roots in ancient practice of acupuncture. Nearly 3,000 years of Chinese acupuncture has resulted in regional Asian variations in technique and ideology.[18,19] Development of modern Chinese medical and therapeutic practices has combined with western empirical medical practices to result in the practice of dry needling. This is the use of filiform needles to treat myofascial trigger points without reference to oriental medicine philosophy and principles of practice. Dr. Janet Travell developed and popularized the treatment of myofascial trigger points (MTrP) using dry needling techniques.[20,21] This method of myofascial pain management has become popular among physical therapists and medical doctors worldwide, especially over the past 3 decades. Histopathology, electrical activity, neurophysiology and clinical features of MTrPs have been studied since the 1940s, and though this body of knowledge continues to grow, the mode of efficacy of needling MTrPs remains poorly understood.

Myofascial Trigger Points, Definitions, and Mode of Efficacy

A MTrP is defined as a highly localized and hyper-irritable spot in a palpable taut band of skeletal muscle tissue.[22] The main criteria used for diagnosis of MTrPs are the following: a tender spot in a taut band of contractile skeletal muscle, patient pain report upon palpation of this point, a predictable pattern of referred pain from palpation of this point, and a local twitch response elicited upon palpation.[3] Despite widespread use of these criteria, there have been few studies that have examined inter-examiner reliability and diagnostic sensitivity and specificity,[3,23-24] nor has there been standardization of the manner in which the examination is conducted.[21]

TRIGGER POINT THEORY AND NEEDLING RESPONSE

Trigger points are known to occur and to be maintained at the level of a spinal segmental reflex.[2] It is thought that excessive local release of acetylcholine[2] or calcium[22] at the neuro-motor endplate results in spontaneous electrical activity (SEA), with sustained depolarization and shortening of sarcomeres.[21] The resultant prolonged local muscle spasm is thought to impair blood

flow, cause tissue damage, and perpetuate an inflammatory cycle.[2,21,22] To date, therapy has been aimed at inhibiting muscle spasm and reducing the pain of MTrPs using many modalities, including spraying with ethyl chloride followed by specific stretching, deep massage, injection of various substances, and dry needling.[2,21,25] Elicitation of local twitch response has been demonstrated to occur with needle insertion into active MTrPs.[2,21,26] Pain relief is associated with reduced electrical activity following needle insertion into an MTrP in which a twitch response is observed.[21,22,26,27] Activation of spinal endogenous opioids is a likely factor in the effectiveness of many therapeutic interventions in pain management. Direct stimulation of peripheral nociceptors by needling may act to desensitize the central nervous system via SEA endplate inhibition and enhance stimulation of opioid activity within spinal wide-range dynamic neurons.[22,28] While acupuncture and dry needling are theorized to have similar mechanisms of action, the education, philosophy of practice, and techniques are quite dissimilar.

COMPARING ACUPUNCTURE AND DRY NEEDLING

Acupuncture is one of the oldest forms of therapy, and is based on Chinese philosophy, namely that disease is an outward manifestation of internal imbalance of Yin and Yang energetic forces.[18] Although filiform needles are used in both dry needling and acupuncture, the similarities are limited. Whereas acupuncture is used to diagnose and manage systemic conditions, dry needling of myofascial trigger points purportedly targets specific tissue responses without reference to energetic systems.[22, 27] Acupuncture education entails 3 years of study with mentored residency and competency examinations. Dry needling certification is adjunctive to a medical degree, or a physical therapy masters or doctoral qualification, which takes 5 to 7 years of study. Certification for dry needling in the United States occurs after 50 hours of post-graduate coursework and 200 to 400 documented interventions. Competency examination is required in the United Kingdom, Europe, and Australia with some programs demanding rigorous dissertations at the culmination of a full academic year of acupuncture related physiotherapy.[29] Such competency exams are similar in depth to APTA board certification areas such as orthopaedic sports, and women's health physical therapy certifications. Medical doctors and physical therapists practice dry needling when it is determined to be within the scope of practice by their relevant states. Available evidence for efficacy of acupuncture and dry needling in myofascial pain is limited, and conclusive results are few.[18,19,25,30] Most studies have been limited by small sample size, nonstandardization of techniques and poor research design, with few high quality studies or systematic reviews. The majority of published manuscripts investigating the effects of acupuncture and needling underscore the need for high quality clinical research in this area.[18,30-32]

Dry Needling Within the Scope of Physical Therapy Practice

Canada, the United Kingdom, Ireland, the Netherlands, Norway, Switzerland, Belgium, Spain, Chile, South Africa, Australia, and New Zealand, among other nations, and some 18 states in the United States have determined that dry needling techniques fall within the scope of physical therapy practice.[33,34] Other states such as California, New York, North Carolina, Hawaii, and Tennessee have proscribed the practice outright.[35] In order to understand the potential benefits and risks of amending state practice acts, the arguments of the stakeholders on both sides need to be addressed.

ACUPUNCTURISTS

Acupuncturists have been licensed to practice in the US since 1973[36] and many programs obtained national certification in 1982,[37] culminating in 16,000 acupuncturists currently in practice[38] nationwide. Forty-three states require certification for licensure.[39] Acupuncture practitioners have been opposed to the inclusion of dry needling in physical therapy practice acts in Virginia and Colorado[40,41] and other states.[35] Their objections are based on the duration of the needling certification programs, concerns for the safety of patients and encroachment on professional territory by physical therapists.[35,40,41] with resultant specific criteria changes to the practice acts in these states. Acupuncture professional associations claim that physical therapists can become certified in dry needling techniques with a course of only 54 hours, while the majority of acupuncture certification programs have requirements of 1,905[42] to 3,000 hours of education from some 57 accredited programs.[35,43] This claim disguises the fact that dry needling certification is a postgraduate course following graduation from one of 200 masters or doctoral physical therapy programs that receive accreditation from the Commission on Accreditation in Physical Therapy Education (CAPTE).44 Entry-level DPT programs typically comprise 2,676 hours of education[33,45] and a more extensive anatomy component than acupuncture programs.[33]

Concern for patient safety is not without merit, since skin penetration carries risk of infection, disease transmission, and potential injury to soft tissue, nerve, and blood vessels. However, there is no documented evidence of increased litigation involving therapists practicing dry needling or other skin penetration techniques in states where this is allowed.[46,47] Regarding the territorial concerns, acupuncture practitioners are concerned that the use of dry needling by physical therapists encroaches on their professional practice grounds. Dry needling has been identified as a component of acupuncture practice, with acupuncturists invited to participate and teach on dry needling courses.[14,46] However, dry needling practitioners limit their practice to management of MTrPs, with no claim to diagnosis or management of systemic disease processes. Diagnosis and treatment of conditions using oriental medicine techniques remains the domain of the acupuncture and oriental medicine professions, and this is affirmed by physical therapy practitioners teaching courses in the United States and internationally.[46]

PHYSICIANS

Physicians in particular, have been concerned about skin penetration by physical therapists, objecting to the use of electromyography (EMG) by physical therapists despite the inclusion of such procedures in many state physical therapy practice acts for decades.[33,46,48] Several states license physical therapists to use skin penetration in EMG testing,[33] and to date there has been no documentation of any injuries or health hazards for such therapists.[33,46] Insurance companies providing liability coverage for physical therapists practicing dry needling impose no additional requirements, other than that they practice in a state that permits the technique.[47]

CHIROPRACTORS

The Maryland chiropractic profession took an interesting position towards dry needling, initially opposing dry needling, determining that it fell within the regulatory

practices of the state board of Acupuncture. However, the Maryland Chiropractic Board reversed its position in 2007 and allowed chiropractors to use dry needling under their physical therapy privileges, since the physical therapists in the state had been licensed to do so since 1987. As in other states and international communities, acupuncture is determined to be "the use of oriental medical therapies for the purpose of normalizing energetic physiological functions including pain control, and for the promotion, maintenance, and restoration of health.[36,41,49] The Maryland Chiropractic Board ruling was based on the fact that acupuncture uses needle insertion into fixed points and is based on pre-scientific philosophies, whereas dry needling into myofascial trigger points is solely a local soft-tissue technique. Thus dry needling is not based on Chinese philosophy of energetic systems, does not constitute acupuncture, and is therefore not subject to the regulation of the acupuncture licensing boards.[49]

PHYSICAL THERAPISTS

The APTA is the national professional organization of 72,000 physical therapists in the United States.[8] The APTA does not yet have an official position on dry needling by physical therapists, but recognizes that it is a technique being used by some of its members.[50] The APTA acknowledges that state licensing boards, which have jurisdiction over administration of each state's PT act, have been consulted regarding whether dry needling falls within the scope of practice. The answer across the states is mixed, with 5 states explicitly proscribing dry needling (NV, NY, NC, ID, TN), stating that it is not in the scope of practice. Fifteen boards have interpretive opinions that it is within the scope of practice in states allowing it, and there have been no definitive statements by the remaining 32. Arizona and Pennsylvania are legally prohibited from issuing an interpretive statement. Statements by physical therapy boards in the 18 states that have amended the scope of PT practice to include dry needling include language stipulating that neither the state medical board nor the acupuncture board could rule on the eligibility of appropriately trained physical therapists to practice dry needling.[51,52] Some states issue contradictory statements. For example, Florida proscribes "skin penetration" in dry needling by physical therapists, but allows them to perform and analyze EMGs, which by definition involves skin penetration. Tennessee takes the position that since no academic institutions in that state teach dry needling to physical therapy students, it should remain outside of the scope of PT practice.[33] This introduces the dilemma of what to do once dry needling is part of entry-level DPT programs, as it is currently at Georgia State University,[53] for example. It may be time to encourage a national review of the scope of practice for physical therapists. A recent report by the Federation of State Boards of Physical Therapy (FSBPT) outlines that there is a historic basis, education and training, and a scientific basis for use of dry needling by physical therapists, provided competency is determined to ensure safe practice.[54] The FSBPT conducts an analysis every 5 years to determine actual practices within the profession. Also, the highly respected American Academy of Orthopedic Manual Therapists supports dry needling in the PT scope of practice and indicates that research supports its use.[55] As with any policy or practice change, the process is likely to be slow and piecemeal in nature, but gradual implementation of such changes can facilitate reflection and necessary critical analysis. In order to reflect on the possibility of changing the scope of practice of physical therapists, it is important to understand the process by which practice guidelines are determined.

Determining the Scope of Practice for the Physical Therapists

In the United States, state physical therapy boards determine the legal scope of physical therapy practice in each state. The Federation of State Boards of Physical Therapy (FSBPT) Model Practice Act provides language to states for reference and consideration in the development of their individual practice acts. In evaluating the current climate of health care practice and education, the FSBPT recognizes the overlap of many skills and procedures among professions, stating that it is "no longer reasonable to expect each profession to have a completely unique scope of practice."[54] Devised with the collaboration of the medical, nursing, social work, pharmacist, occupational and physical therapy professional communities, the FSBPT document provides a protocol for state boards to use in decision making about whether an intervention should be included in the scope of practice. This protocol assists in decision-making when considering practice act changes, with the primary focus on whether the proposed changes "will better protect and enhance consumers' access to competent health care services."[54] Proposed changes to the scope of practice should evaluate 4 critical areas: established history of specific practices, adequate training, adequate evidence of benefit to public health, and appropriate regulation. The FSBPT maintains that adequate evidence in each of these areas suggests that scope of practice changes would be in the public's best interest.[54] This position echoes that of the Federation of State Medical Boards (FSMB), an allied, parallel organization for physicians and osteopaths. This group outlines the multifactorial nature of scope of practice decisions, including workforce needs and availability, financial motivations, economic circumstances, and consumer demand, with the ultimate goal of protecting public health and safety.[56] In order for there to be a rational, useful approach to broadening the scope of practice of a health care practitioner, there must be judicious use of the guidelines that have been developed for this purpose.

Guidelines for Changes to the Scope of Practice

According to the FSBPT and the FSMB, scope of practice should be reviewed when the following factors have been considered: where there exists a need for the proposed scope of practice; when the existing scopes of practice, if altered, will result in a positive change in public health and safety; where there exists formal education, training, and accreditation processes for the change in scope of practice; where appropriate evaluation and disciplinary procedures are established; where accountability and liability issues have been clarified and where the effects on other practitioners have been reviewed.[54,56] Using these criteria, the broadening of the scope of practice for physical therapists to include dry needling, would be approved. First, more than a third of the US physical therapy boards have issued interpretations that dry needling is within the PT scope of practice. Such changes in physical therapy state practice acts parallel the practices of Canada and many countries in Europe, Asia, and South America. Second, there has been no increased incidence of injury to the health of patients when managed by physical therapists who use techniques that puncture the skin. Third, there are 3 main US programs for accredited needling education programs, and reciprocity already exists among the international programs for dry needling certification. Fourth,

physical therapists practicing dry needling are accountable under standard rules of practice, and have the same requirements to carry malpractice and liability insurance as those who do not practice needling. Finally, there is no documented adverse financial effect on other practitioners when physical therapists are licensed to practice dry needling. In fact, there may be an opportunity for both acupuncturists and physical therapists to improve their position in the market if both groups could market their nonsurgical, nonpharmaceutical approach to pain management.

Planning or Policy Strategies that Might Mitigate Differences

In negotiations, success results from collaborative efforts to resolve any impasse.[57] The APTA and the American Association of Acupuncture and Oriental Medicine (AAAOM) could collaborate on combined statements, with a unified marketing campaign for consumer education to differentiate between acupuncture and dry needling. University programs for dry needling could be developed in collaboration with all interested parties.[33,58] Combined physical therapist and acupuncturist lobbying for third party payor reimbursement could be more successful than the current situation where each professional community struggles for reimbursement independently.[59,60] Benefits could include improved teamwork of medical doctors, physical therapists, and acupuncturists to optimize patient care. Reduced costs for the consumer could result as all providers compete in the open market for myofascial pain management services. As continued research would determine best practices, collaborating professionals would be quick in adjusting their practice to reflect new knowledge. The concept of an extended scope of practice for physical therapists is not an expansion of physical therapists interest in needling therapy, but is a component of a global shift in health care service utilization.

Extended Scope of Practice in Health Care Professions

An international summit on advanced scope of practice and direct access to physical therapy was held in Washington in October 2009 to examine current international demands and practices, and to determine the implications of increased practice scope on interprofessional relationships, professional boundaries, and role definitions.[61] National and international developments

to alter the scope of practice of physical therapists and other medical professionals are underway, in order to mitigate the current stresses on the health care system.[54,56,61] These scope of practice changes follow the development of the nurse practitioner and physician assistant professions, whose origins as legitimate medical professionals grew, in the past 50 years, out of the financial and workforce constraints on the general physician and medical community.[62,63] Physical therapists are currently being trained in joint injections,[64] musculoskeletal triage in emergency rooms,[65] and first-line health care management.[66] The changing tide of clinical practice is not likely to reverse, as increasing demands on finite financial resources continue.[1]

SUMMARY

Current US and International Practice, Recommendations for the Future

Dry needling is already within the scope of physical therapy practice in many areas (18 US states[34]); skin penetration by physical therapists for EMG is allowed in many US states, and Canada, South America, Europe, Asia, Australia, and New Zealand. With minimal risk and increased benefits to the majority of stakeholders, dry needling practiced within an increased scope of PT professionals will be of benefit to the public, bringing American clinicians in-line with their international colleagues.

The APTA's "2020 vision" for physical therapy includes a commitment to lifelong learning with use of evidence-based practice.[6] Articles published in respected, peer-reviewed journals underscore the continued need for expert clinicians to critically appraise and conduct research. The current emphasis in physical therapy education is on research to support and challenge clinical practices. With increasing use of dry needling by physical therapists, the research emphasis should include dry needling within efficacy and comparative effectiveness studies. Doctoral level physical therapists who acquire these skills as part of their core curricula[67] are well suited for such analysis and research, and their dissertations could explore the comparative effectiveness of dry needling and other manual therapy techniques.

Many techniques are not unique to a specific profession. There are ongoing battles for territory between chiropractors and physical therapists over manipulation and joint mobilization,[68,69] between athletic trainers and physical therapists over manual therapy techniques,[70] with physicians and physical therapists performing EMG tests,[71,72] and physicians referral to in-house physical therapy practices.[73,74] The global trends in health care management are to look broadly across the professional spectrum to determine where patients can benefit from skilled care provided by appropriately trained clinicians, at the lowest cost. The future objective will be to use best practices for best outcomes and for the best financial value. The territorial battles are likely to continue, but will diminish in intensity as adversaries compete to demonstrate optimization of outcomes and not compete over ownership of specific techniques.

CONCLUSIONS

Physical therapists are positioned as expert clinicians in the health care community with a broad spectrum of techniques for nonsurgical management of musculoskeletal pain and dysfunction. Inclusion of dry needling within the scope of PT practice will ensure further high-quality research and clinical practice with better outcomes in this field. Use of dry needling by qualified, licensed physical therapists will bring American physical therapy professionals in line with current international standards of practice, and provide patients with more options for management of musculoskeletal pain. In the costly arena of arthritis, movement dysfunction, and pain management, extending the physical therapy scope of practice to include dry needling will improve in consumer choice, increase evidence-based practice, and facilitate cost-containment.

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Nominations

Orthopaedic Section Awards

Now is the time to be thinking about and submitting nominations for the Orthopaedic Section Awards! There are many therapists in our profession who have contributed so much, and who deserve to be recognized. Please take some time to think about these individuals and nominate them for the Orthopaedic Section's highest Awards. Let's celebrate the success of these hard-working people!

Visit our Web site for more information about the awards offered by the Orthopaedic Section and the criteria for nominating an individual: http://www.orthopt.org/awards.php.

- James A. Gould Excellence in Teaching Orthopaedic Physical Therapy
- Outstanding Physical Therapy & Physical Therapist Assistant Student Award
- Paris Distinguished Service Award
- Rose Excellence in Research Award
- Richard W. Bowling - Richard E. Erhard Orthopaedic Clinical Excellence Award

Book Reviews

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

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Orthopaedic Practice (OP) is interested in having readers serve as book reviewers. Previous experience is recommended but not required. Timeliness in meeting publication deadlines is required. Invitation is only open to Orthopaedic Section members. Successful completion of each review results in the reviewer retaining a free copy of the textbook.

If you are interested, please contact Michael Wooden, Book Review Editor for OP at: michael.wooden@physiocorp.com

Fundamental Orthopedic Management for the Physical Therapist Assistant, 3rd ed, Elsevier, 2011, $50.95
ISBN: 9780323056694, 520 pages, Soft Cover

Editors: Shankman, Gary A., PTA; Manske, Robert C., PT, DPT, MEd, SCS, ATC, CSCS

Description: This is the third edition of a book committed to bringing fundamental orthopedic rehabilitation practice pattern changes to the education of physical therapist assistants. The first edition was published in 1997 and the second edition was published in 2004. **Purpose:** The book focuses on the critical thinking and application of the physical therapy examination, development of treatment plans, and interventions that can be used by physical therapist assistants during orthopedic clinical practice. It is the editors' intent that this book remain focused on the scope of physical therapist assistant practice, rather than that of general orthopedic physical therapy. **Audience:** It is designed for physical therapist assistants who practice in an orthopedic setting. **Features:** The 16 chapters in the first four parts of the book discuss basic concepts of orthopedic management, tissue healing, common medications in orthopedics, and concepts relating to mobilization and biomechanics. The seven chapters in the next part take a regional approach to covering the spine, upper extremity, and lower extremity. Each of these chapters generally follows a similar format, with descriptions of common injuries, conservative and surgical management, and rehabilitation considerations in terms of therapeutic exercise and joint mobilization techniques. The last section of the book has three chapters on the management of rheumatic disorders and pain, as well an introduction to orthotics and prosthetics. Each chapter contains key terms, learning objectives, and review questions. Images, line drawings, and diagrams are routinely used to supplement the text, and up-to-date reference lists are provided at the end of each chapter. Additional helpful features include five quick-reference appendixes with information such as commonly used medications and reference ranges for medical laboratory tests, as well as access to online resources, such as critical thinking applications, review questions, animations, and links from the references to Medline. **Assessment:** This book has moved from a single-author work to one with two editors managing multiple contributors who are experts in their respective areas. This approach has greatly enhanced this book, which is a valuable teaching text and a key resource for physical therapist assistants working in orthopedic settings. It is also well suited for use as the primary textbook for orthopedic physical therapist assistant courses.

Michael D Ross, PT, DHSc
(United States Air Force)

Joint Range of Motion and Muscle Length Testing, 2nd ed, Elsevier, 2010, $64.95
ISBN: 9781416058847, 509 pages, Spiral Cover

Authors: Berryman Reese, Nancy, PhD, PT; Bandy, William D., PhD, PT, SCS, ATC

Description: This book describes testing techniques for joint range of motion and muscle length testing, while a companion DVD demonstrates the techniques. This is an update of the 2002 edition. **Purpose:** The purpose was to improve upon the first edition, providing clinicians and students with a more comprehensive manual. The addition of the DVD and a chapter on pediatric range of motion, as well as updating the literature, all help to achieve this goal. **Audience:** The book is designed to be used by students and clinicians who are required to take range of motion measurements and test the length of muscles. Because the book covers testing of the spine, upper extremities, and lower extremities, it is primarily geared towards those in the physical therapy profession. **Features:** Sections cover joint range of motion and muscle length testing of the upper extremities, lower extremities, and the head, neck, and trunk and conclude with a chapter detailing the reliability and validity of testing of each body segment. Chapters use the same format to enable readers to easily go through the material. The DVD and the line drawings clarify how each procedure is done, which is helpful for students learning this for the first time. An appendix at the end of the book includes sample recording forms and normative values for range of motion in adults for the spine and extremities. Although each chapter has a sufficient amount of references, the one weakness of the book is that several of the references are well over 10 years old, and the latest editions of some books are not used, despite being published within at least the last two years. However, even with this weakness, the book still offers a well-structured format that is easy to follow for performing joint and muscle length testing. **Assessment:** Overall, this is a good update from the previous edition, especially with the addition of the DVD, the chapter on pediatric range of motion, and the changes in graphics. Even though the references in the book are older, the technique of range of motion testing has not changed significantly over the years. Therefore, the book is still a good contribution to the field and useful, especially for students.

Michelle Finnegan, DPT, OCS, MTC, FAAOMPT
(Bethesda Physiocare)

OCCUPATIONAL HEALTH

SPECIAL INTEREST GROUP

GREETINGS OHSIG MEMBERS!

We have had a very active past couple of months! Hopefully you had the opportunity to respond to one or more of the initiatives we let you know about. Here are the activities we have been engaged in on your behalf these past months!

ANNOUNCEMENT OF OHSIG BULLETIN BOARD

In the last issue of *OPTP*, Vol 23, No 3, 2011, we announced the OHSIG Electronic Bulletin Board on the Orthopaedic Web site. This is an active communication link for OHSIG members only! It is a great place to ask questions of your colleagues and share ideas. As of this writing, there have been 15 various topics discussed.

The link is https://www.orthopt.org/message_boards.php. Login is required.

For those of you who have not used an asynchronous communication (not all users have to be online at the same time) platform before, you can use the Online Bulletin Board whenever:

- you want to mail a single message to other OHSIG members, or
- you want to brainstorm or communicate ideas to foster discussion.

GUIDELINES:

1. All members will see your messages.
2. Be courteous.
3. Keep messages clear and goal directed.
4. Messages should be related to Occupational Health.
5. We will be unable to accept postings pertaining to advertisements or employment opportunities.

Please make every effort to use correct grammar, punctuation, spelling, and sentence structure. Most of all have fun! This is a benefit of belonging to the OHSIG. We hope you will use it!!

UPDATE: PETITION FOR SPECIALIZATION IN OCCUPATIONAL HEALTH PT

We received a response from the ABPTS regarding our Petition for Specialization in Occupational Health. Many questions were posed and clarifications were requested. A call was held with the Orthopaedic Section President, Jay Irrgang, OHSIG Liaison to the Orthopaedic BOD; Bill O'Grady, ABPTS representative; Lorena Pettit, OHSIG VP; and myself. It was determined that OHBOD would hold a face-to-face meeting mid September to respond to questions posed by ABPTS. Our goal is to continue the path toward Specialization in OHPT.

WCPT

Dee Daley, past OHSIG VP/Education Chair and current Content Expert for Occupational Health PT Specialization, attended the World Confederation of Physical Therapy Conference in Amsterdam, The Netherlands. Here is her report. It sounds like there were very collaborative and informative presentations!

Moving Forward - Occupational Health at WCPT by Dee Daley

Forty-eight physical therapists from Australia, Brazil, Canada, Finland, Germany, Japan, Netherlands, Nigeria, Norway, Puerto Rico, Sweden, Thailand, Uganda, United States, and Zimbabwe participated in a WCPT satellite program related to current practice and future trends related to occupational health physiotherapy practice related to work injury prevention and management. The program titled *"Moving Forward - Occupational Health"* was a collaborative presentation of physical therapists from 4 WCPT regions.

The full day of programming included programming on risk management and ergonomic tools as well as the practical application of ergonomic tools, evaluation of work capacity, job analysis, and the implications of biopsychosocial aspects of musculoskeletal disorders for rehabilitation and return to work. Emerging research, updates, and regional perspectives on material handling, safe patient handling, work stress, progress, and barriers in the areas of work injury/illness prevention and successful rehabilitation/return to work were also topics covered in the various sessions

Faculty included: Paul Rothmore (AUS), Rose Boucaut (AUS) (co-chairs), Martin Mackey (AUS), Dee Daley (US), Mike Fray (UK), Gunvor Gard (Sweden), Elisabet Schell (Sweden), and Venerina Johnston (AUS).

In addition to an occupational health networking session on Tuesday of WCPT, an abstract session in occupational health included the following:

- Physiotherapists use of a guideline for reducing work related musculoskeletal disorders *(Inger Helene Gudding, Norway)*
- The development of a cumulative psychosocial risk index for problematic recovery following physical therapy for work-related musculoskeletal injuries *(Timothy Wideman, Canada)*
- Physical and mental workload in computer tasks: effects on cervical muscle activation, cardiovascular response, and perceived stress in computer users *(Yuling Wang, China)*
- Effectiveness of exercise on work disability in patients with non-acute nonspecific low back pain: a meta-analysis of randomized controlled trials *(Peter Oesch, Switzerland)*
- Biofeedback is more effective than exercise and electrotherapy in managing work-related neck pain in office workers *(Pui Yuk Grace Szeto, Hong Kong)*
- Physical profile of professional orchestral musicians: a national cross-sectional study *(Bronwen Ackermann, Australia)*

***** On behalf of the OHSIG, a special thank you to Dee for her participation at WCPT and for representing the United States and the OHSIG! *****

OHSIG ACTIVITIES--MEMBER PARTICIPATION

- APTA requested CMS to add a new Place of Service code for "work-site" to identify services that are delivered at the workplace when the practitioner does not maintain an office at that work-site. Karen Jost, Associate Director Payment Policy & Advocacy, APTA, informed the OHSIG that this request was being considered, and she requested additional information from OHSIG members. OHSIG members responded, providing her with the information she needed.
- OHSIG provided evidence for the efficacy of work hardening and work conditioning procedures with clinical examples for the Regulatory and Payment Counsel of APTA.
- OHSIG members participated in an International Multi-stakeholder Return-to-Work (RTW) Survey.
- OHSIG submitted feedback to the Massachusetts HCSB Chronic Pain Treatment Guideline draft.
- OHSIG was asked to review the Employment Services Standards related to CARF's Employment and Community Services customer service unit. They convened a series of International Standards Advisory Committees and focus groups to review and revise standards in the area of Employment Services. Anita Bemis-Dougherty, Associate Director, Department of Practice, APTA, asked for our review and comments to proposed standards.

As a reminder, be sure to watch for E-mail blasts from the OHSIG. If you do NOT receive E-mail blasts from us and you are an OHSIG member, please contact Tara Fredrickson at the Orthopaedic Section office (800-444-3982 x203) or contact any of the OHSIG BOD. These E-mail blasts are usually time sensitive, so E-mail blasts are the best method of communication for us. Also, we will use the OHSIG Bulletin Board when we can.

NEED AUTHORS

If you are interested in submitting an article for OPTP, please let us know.

MEMBER INVOLVEMENT

If you have suggestions, questions, or comments, contact any of the BOD members. We'd love to hear from you! You can find the officer listing on the Orthopaedic Section Web site, under Special Interest Groups.

Professional Regards,

Margot Miller, PT
OHSIG President

CLINICAL CORRELATION OF EVIDENCE TO FORM A FUNCTIONAL CAPACITY EVALUATION OPINION

By Sandy Goldstein, PT, CDMS

Often, the results of imaging studies (x-ray, CT, ultrasound, or MRI, among others), require clinical correlation. When a radiologist comes across a finding that may mean multiple things, they say "please correlate with clinical findings" or "clinical correlation requested." In medicine, "clinical findings" are observable signs of a particular condition or disease, along with symptoms as reported by the patient. A test, as explained above, is "correlated" or "compared to" or "compared with" the observable signs and reported symptoms before a final diagnosis is made. Clinical findings can be made any time a physician examines and interviews a patient; most often, this occurs in a doctor's office or while a patient is in the hospital.

In the Functional Capacity Evaluation (FCE), our findings and subsequent opinions are based on a combination of historical, medical, and clinical findings. When we put our name on the dotted line and assert that our "opinion is accurate and complete to a reasonable degree of occupational health or ergonomic probability," we are offering an opinion that is reflective of our clinical expertise together with the objective data collected before, during, and after the FCE.

The purpose of this article is to clarify that opinions offered following a well-performed FCE will include a summary of our subject's medical history, vocational history, objective diagnostics, medication regimen, recent lifestyle activities, as well as the results of what they were willing to do on test day balanced with an assessment of their effort and consistency of performance.

COLLABORATING EVIDENCE TO FORM OPINION: MEDICAL HISTORY, EXAMINATION & EVALUATION, FUNCTIONAL TESTING & OBSERVATION OF THE SUBJECT

As the American Physical Therapy Association (APTA) *Guidelines for Evaluating Functional Capacity* identify, components of an FCE should include but are not limited to appropriate administration, documentation, and consideration of the following when providing an opinion regarding an individual's functional ability:

Medical history including:

- Mechanism of injury
- Treatment to date
- Objective diagnostic tests
- Surgeries
- Other relevant claims/medical history

- Report of current symptoms and work/leisure limitations
- Current medications

Examination and evaluation of:
- Cardiovascular/pulmonary tests and measures
- Integumentary tests and measures
- Musculoskeletal tests and measures
- Neuromuscular tests and measures

Functional testing including:
- Static strength tests to evaluate consistency of effort (eg, grip, pinch, pull)
- Dynamic balance/agility
- Finger dexterity tests
- Manual dexterity tests
- Cardiorespiratory endurance tests
- Postural tolerance tasks
- Lift/carry strength and endurance tests
- Simulated or actual work tasks

Observation of the subject:
- Cooperation during participation
- Consistency and level of effort
- Behaviors that interfere with physical performance
- Body mechanics/safety
- Physiological responses and clinical findings

The results of the above are considered in combination with the evaluation of history, medical records, and test performance to recommend safe work abilities. Moreover, a comparison of the individual's safe work abilities to their job or task demands (if known) is provided.

IN SUPPORT OF CLINICALLY CORRELATING FCE RESULTS

Historically, return-to-work decisions were based upon "clinical findings" including diagnoses and prognoses of physicians, but did not include objective measurements of worker functional abilities and job match demands. There were no tools for physicians to use to correlate their opinions or clinical findings.

The FCE emerged to elevate the available information used to provide objective assessment of an individual's safe functional abilities compared to the physical demands of work or leisure tasks.

Functional examination/evaluation, combined with diagnoses and prognoses by physical therapists has emerged as a valid and effective tool to support safe return to work or lifestyle activities after an injury or illness.

In Chapter 16 of the *Guide to the Evaluation of Functional Ability*, Genovese & Galper 2009, the chapter authors clearly make the case that an FCE is a clinical evaluation used to answer questions about a person's abilities (and limitations) relative to a medical condition.

The discussion points out that many FCE evaluators do not produce reports that clinically correlate medical findings (found during the FCE or from review of medical records) with the functional findings of the FCE. In fact, the authors point out that reports they have reviewed provide evidence that some evaluators believe that:

1) all the clinician has to do is gather data and input it into their computer;
2) the FCE protocols are stand-alone and that the scoring procedures allow an individual's physical abilities to be determined independent of any clinical judgement;
3) the evaluator's role is more technical than clinical, simply observing performance and recording results.

These points could not be further from the truth. Clinical judgment within the functional testing process is a must in order for the findings of an FCE to be valid and practical.

CASE IN POINT: AN EXAMPLE OF CLINICAL CORRELATION DURING FCE TESTING

Tony –
- Diagnosis: s/p C4/5, C5/6, C6/7 disc herniations with associated radiculopathy and myelopathy.
- Surgical intervention: anterior cervical partial vertebrectomies, diskectomies, spinal cord nerve root decompression at all three levels with interbody fusions.
- Target Job: Parking Lot Cashier (considered within the Light physical demand classification according to the Dictionary of Occupational Titles, 1991 definition).
- Limiting Health Conditions (per self-report): "I fall 2-3X per month," and "I drop objects out of my hands."
- Pertinent Self-report of Activities of Daily Living:
  - "use a chair for showering;"
  - "don't cook, never know when the shocks are coming;"
  - "standing/walking, legs get wobbly;"
  - "stairs, can't do-keep falling."
- Current Complaints: Intermittent neck stiffness, left sided low back pain, and bilateral lower extremity pain, tightness, and numbness.
- Assistive Device: Uses a quad cane for community or home based ambulation assistance and a scooter for distance.
- Neuromusculoskeletal Exam Summary:
  - Moderate decreased cervical ROM and lumbosacral ROM
  - Bilateral sustained (> 5 beats) ankle clonus
  - Upper extremity and lower extremity strength testing WFL throughout
- Standardized Functional Test Results Scores:
  - Very low aptitude for ambulation agility and dynamic balance
  - Low aptitude for ambulation stamina
  - Very low aptitude for climbing
  - Low aptitude for finger dexterity
  - Low aptitude for manual dexterity
  - Occasional standing tolerance
- Performance Results
  - Cooperative and provided good consistent effort
  - No unusual or inconsistent symptoms
  - No superficial tenderness or non-anatomic tenderness

- o No inconsistent weakness or strength
- o No inconsistent movements with distraction
- o No unusual pain behaviors or overreaction
- o No abnormal function in unaffected regions
- o No refusal to attempt specific tests
- o No overestimation of safe-work abilities

In considering Tony's case, the combination of his medical history and diagnoses, self-report of limitations and performance of his daily activities, neuromusculoskeletal findings combined with the functional testing, it was clearly shown that he would be unable to perform the ambulation demands of work as a Parking Lot Cashier.

Tony's sustained clonus reaction was present throughout all weight bearing functional tests and was supported by the examination, medical history, and self-report. In other words, his low tolerance for standing and low aptitude for walking, climbing, and endurance were well supported by considering all the available evidence.

Prior to the FCE, the veracity of his limitations were in question, following the FCE, the case was settled.

IN SUMMARY

A skilled FCE evaluator must demonstrate that the underlying health condition(s) have an effect on the individual's functional performance, or visa versa. It is for these reasons that the FCE can only be properly performed by professionals knowledgeable in anatomy, physiology, pathology, and kinesiology; have skills in clinical and functional evaluation methods; and the ability to draw conclusions by considering the person's injury or illness in the context of all other findings.

REFERENCES

1. American Physical Therapy Association. *Occupational Health Guidelines: Evaluating Functional Capacity*. Alexandria, VA: American Physical Therapy Association; 2010.
2. Gambert SR. The importance of clinical correlation and impact of testing choices on clinical care and outcome. *Clin Geriatr*. 2006;14(5):6.
3. Genovese & Galper. *Guide to the Evaluation of Functional Ability*. USA: American Medical Association; 2009:1-17.
4. US Department of Labor, Employment, and Training Administration. *Revised Dictionary of Occupational Titles*. Vol 1 and 2. 4th ed. Washington, DC: US Department of Labor, Employment and Training Administration; 1991.

Sandy Goldstein is Proprietor and General Manager of Sandy Goldstein & Associates. He originally trained as a physical therapist, and later advanced his postgraduate skills with training and certifications in Social Security disability law, life care planning, disability management, return-to-work program development, and functional testing. He has built a foundation of broad expertise during his 13+ year career. Mr. Goldstein has performed hundreds of functional capacity evaluations and other forms of stay-at-work/return-to-work assessments and has designed programs that simultaneously align incentives, improve outcomes, and reduce costs. He holds the position of Communications Chair for the OHSIG.

PAIN MANAGEMENT

SPECIAL INTEREST GROUP

PRESIDENT'S MESSAGE

John E. Garzione, PT, DPT, DAAPM

This summer seems to have flown by faster than normal with all of my good intentions of moving programs forward remaining as intentions. If I present these to you, the members, I will not be able to hide behind the ideas and have to get acting on them.

(1) The Independent Study Course in Pain Management is in the planning stages.
(2) The PMSIG member profile page should be expanded to provide visitors to the Web page, a listing of member's treatment interests.
(3) Encourage more PMSIG articles to be published in *Orthopaedic Physical Therapy Practice*.

Well, that's enough soul searching for me at this time; I better get busy.

The Combined Sections Meeting is in "sunny" Chicago this February and the PMSIG programming entitled "Chronic Pain: Myths, Measures, and Management" by D. Dailey and K. Sluka is slated for Friday, February 10. More information will follow in the next issue of *Orthopaedic Practice*.

With the variations in summer weather, I have recently wondered why some people seem to have more "weather related" symptoms than others. A study published in the *Annals of Rheumatologic Diseases* in 2002 reported that a statistically significant relationship between fibromyalgic pain and the weather was not found in their sample either on the same day or on the previous day. They did however find that those with < 10 years of fibromyalgia experienced significantly greater weather sensitivity to pain than those with longer illness.[1]

A 2003 Japanese study published in the *International Journal of Biometeorology* found that there was a direct connection between low pressure, low temperatures, and joint pain in rats. In the first documented animal behavioral study of weather effects on joint pain, scientists artificially produced chronic inflammation of the rat's foot, which was analogous to clinical features of human neuropathic pain. When the rats were placed in a low-pressure, low-temperature environment, they exhibited signs of foot joint pain that were not seen in control rats.[2]

Some people are sometimes described as "weather sensitive." They speak of "feeling under the weather" and "my aches and pains speak of coming rains." Their ailments appear to be aggravated by certain weather conditions such as damp, chilly conditions, rising humidity, rapidly changing barometric pressure, and gusty winds. These particular conditions may cause swelling of the joints and it may be that the swelling irritates the nerves around the joints that sense the pain. It is likely that the joints' membranes act as a barometer and expand as the air pressure drops. This in turn can cause increased pressure in the synovial fluid. More resistance to movement is then offered and it increases the pains in the joints already affected. The change in barometric pressure--the pressure that air exerts on the environment--may cause a transient "disequilibrium" in body pressure to sensitize the nerve endings, which would account for the increased pain preceding humidity and temperature changes. The joint receptors, such as the Ruffini and (to a lesser extent) Paciniform endings, can sense pressure changes. Heat and cold can affect how people feel, but I think with achy joints, it has more to do with pressure. Interestingly the Web site www.weather.com has an aches and pains index based on local weather. Whether (excuse the pun) this occurs or not, still reminds us of the individual differences in all of our patients.

Happy Fall,
John

REFERENCES

1. Fors E, Sexton H. Weather and pain in fibromyalgia: are they related? *Ann Rheum Dis*. 2002;61(3):247–250.
2. Sato J. Weather change and pain: a behavioral animal study of the influences of simulated meteorological changes on chronic pain. *Int J Biometeorol*. 2003;47(2):55-61.

IMAGING

SPECIAL INTEREST GROUP

The NEW Orthopaedic Section's Imaging Special Interest Group (SIG) is up to 56 members! We are excited that so many individuals have joined our new SIG in such a short period of time. Our goal is to have 200 members by Combined Sections Meeting in February 2012. Please join the imaging SIG by sending an E-mail to Tara Fredrickson at tfred@orthopt.org.

You may ask – why join the Imaging SIG prior to CSM? Imaging is integral to the field of orthopaedic physical therapy whether you are a clinician, educator, policy maker, or researcher. Additionally, physical therapists that successfully incorporate imaging into their practice will be better positioned in the integrated health care delivery system. Imaging is poised to help take the practice of physical therapy to a higher level. The goal of your Imaging Special Interest Group will be to help provide support, education, and resources so physical therapists can optimally integrate imaging into their practice, foster research using imaging, and promote imaging education.

To that end – we are hoping you will join the Imaging SIG and then join us for our first business meeting at CSM where we will help set the mission, vision, and priorities for the Imaging SIG so that this new group can help meet the needs of the physical therapist within the Orthopaedic Section.

We are looking forward to CSM 2012. We hope you will join us for 3 programs:

Sonography for Common Lower Extremity Orthopaedic & Sports Conditions presented by Drs. Douglas M. White, Wayne Smith, and Joel Fallano

From Protons to Progression of Exercise – How can Conventional and Advanced MRI Applications Guide Exercise Prescription for Neck Pain? presented by Drs. Jim Elliott, Shaun O'Learly, and Barbara Cagnie

We will also have a panel discussion on *Ultrasound Imaging & Scope of Practice.*

ABSTRACT CORNER

Below is a summary of some recent articles published on ultrasound imaging and low back pain. All abstracts can be found on PubMed (http://www.ncbi.nlm.nih.gov/pubmed)

1. Pinto RZ, Ferreira PH, Franco MR, et al. The effect of lumbar posture on abdominal muscle thickness during an isometric leg task in people with and without non-specific low back pain. *Man Ther*. 2011 Jun 25.
2. Saliba SA, Croy T, Guthrie R, Grooms D, Weltman A, Grindstaff TL. Differences in transverse abdominis activation with stable and unstable bridging exercises in individuals with low back pain. *N Am J Sports Phys Ther*. 2010 Jun;5(2):63-73.
3. Pinto RZ, Ferreira PH, Franco MR, et al. Effect of 2 lumbar spine postures on transversus abdominis muscle thickness during a voluntary contraction in people with and without low back pain. *J Manipulative Physiol Ther*. 2011 Mar-Apr;34(3):164-72.
4. Koppenhaver SL, Fritz JM, Hebert JJ, et al. Association between changes in abdominal and lumbar multifidus muscle thickness and clinical improvement after spinal manipulation. *J Orthop Sports Phys Ther.* 2011 Jun;41(6):389-99. Epub 2011 Apr 6.
5. Pulkovski N, Mannion AF, Caporaso F, et al. Ultrasound assessment of transversus abdominis muscle contraction ratio during abdominal hollowing: a useful tool to distinguish between patients with chronic low back pain and healthy controls? *Eur Spine J*. 2011 Mar 31.

Imaging Special Interest Group Officers

President
Douglas M. White, DPT, OCS

Vice President
Deydre Teyhen, PT, PhD

Nominating Chair
Wayne Smith, DPT, SCS

ANIMAL REHABILITATION

SPECIAL INTEREST GROUP

"Members on the Move" - This is a new section we hope to keep as a regular part of our newsletters in the future. It is designed to recognize members pursuing further education or specialization in their field, those receiving accolades for the work they do, or just a way to "toot your own horn!" If you know of anyone that should be recognized in future newsletters, please forward information to Lisa Bedenbaugh at LHinerman2@aol.com.

Carrie Adamson, our SIG Vice President, has recently been awarded a PhD in Canine Biomechanics from the College of Veterinary Medicine and Biomedical Sciences at Colorado State University. Congratulations, Carrie!

Amie Hesbach, our SIG President, has recently been accepted by the University of Montana for her transitional Doctorate of Physical Therapy-best of luck, Amie!

Lisa Bedenbaugh, the SIG newsletter Editor, will be presenting at the Australian Physiotherapy Association's national meeting in Brisbane, on October 30th. She will be talking on "Chiari Malformation in Yorkshire Terriers" and "Trends and Issues Facing PTs in the Animal Rehabilitation Field in the U.S."

Kirk Peck, PT, PhD, CSCS,CCRT, is collaborating with Dr. Jennifer Hebel, DVM, PhD, CCRT, on a joint research project to investigate lumbosacral and sacroiliac joint pathokinesiology that may limit or even completely stop breed specific populations from competing in agility. The purpose of the study will be to explore various factors related to LS and SI joint dysfunction that may impact sport capacity.

UPCOMING EDUCATIONAL OPPORTUNITIES

Through Northeast Seminars: (www.neseminars.com)

"Pain Procedures for PT Patients," presented by Robin Downing, DVM, CCRP, in Loveland, CO on October 21-22.

Canine V - "From Head to Tail; The Business of Canine Physical Rehabilitation," presented by Debbie Gross-Saunders, DPT, MSPT, OCS, CCRP, Nashua, NH on October 21.

Canine V - "From Head to Tail-Treatment for Common Canine Conditions," Debbie Gross-Saunders, Nashua, NH on October 22-23.

Through Canine Rehabilitation Institute
(www.caninerehabinstitute.com)

"Orthotics and Prosthetics in Canine Rehabilitation & Conditioning Group," Patrice M. Mich, DVM, MS, DABVP, DACVA, CCRT, Martin W. Kaufmann, C-Ped, BSBA, Prosthetic/Orthotic Technologist, Broomfield, CO on October 8-9.

Educational Handouts:

Thank you to Amie Hesbach and Massachusetts Veterinary Referral Hospital for the following educational material, appropriate to share with owners:

The following is a list of helpful tips from a former client whose pet was incontinent following spinal surgery. Marie's family hopes that the following will help other people and their pets.

- ✓ [When Marie was allowed on the furniture…] we got a shower curtain and put it over the sofa where Marie loves to spend time. (We stapled it to the back of the sofa since it kept slipping.) An old plastic garment bag works well too, which is what we used to wrap Marie's favorite bed. We line each with a washable 3x5 carpet and doggie pads. I use Clorox bleach pads to clean the shower curtain and garment bag when they get soiled.
- ✓ Marie's favorite place was always the sofa, so we also got a child's bed rail and put it under the sofa cushion to keep her from falling. (She is supervised on the sofa because her inclination is to follow us when we leave the room, which could result in a fall. She is very persistent and found a way around the bed rail, but in the early days it was a help.) (The right bed rail for a sofa was a little tricky to find since most are secured with rails that are as long as a twin bed is wide; just read the packaging carefully. The one we bought has a strap vs. a rail to secure it.)
- ✓ Vinegar is great to help neutralize the urine smell in a non-toxic way. I pour vinegar on a paper towel and place it on the bottom of the wastebaskets where I dispose of Marie's doggie pads or diapers. I also line those waste baskets with a plastic bag (on top of the vinegar pad) to dispose of them daily. BTW, the waste baskets with a cover are best and emptied daily.
- ✓ Buy some foam carpet cleaner for pet stains. (For urine, I blot with vinegar first.) Resolve or other brands are great; just spray them on and wait 5 minutes then blot.
- ✓ I put a large old carpet over the existing carpet to protect against permanent staining, although the carpet cleaner is really doing the trick.
- ✓ We bought baby diapers vs. doggie diapers; they are much less expensive. My personal choice is Huggies organic. Size 4 works for Marie…she's 25 lbs. Just cut a hole in the back for her tail which is important since she has nerves there. We use the diapers at night, and let her private area get as much air as possible during other times of the day to avoid infection.
- ✓ Diaper cream works great if her private area is getting red. Something with zinc oxide is helpful provided she cannot reach it to ingest it.

- ✓ I bought a baby changing table topper and lined it with a towel and doggie pads as a very portable place for Marie to sleep. The sides are contoured and it moves easily around the house. (A typical bed is too soft for her, and reduces her ability to stand.) I'm sure they are available at most stores that sell baby products, but the one I bought ($20 at Walmart) is "Simmons Kids - Two Sided Contour Changing Pad with Non-Skid Bottom."
- ✓ We purchase an essential oil called "Purification" for odor neutralization by Young Living. Just a couple of drops added to water and a spray bottle is non-toxic, good for the environment, has a fresh (non-perfume) scent. (FYI – It also neutralizes cigarette odors; I never travel without it!) This can be purchased on-line or through me.
- ✓ To reduce Marie's sliding on her bum (vs. walking), I got a children's play yard for her and put it up in the front yard. She can still see her doggie friends go by and follow them a few feet, but not enough to get hurt. (Marie is smart and managed to go under it, so we staked it to the ground.)
- ✓ Marie has acupuncture 2-3x/week.
- ✓ We hired a dog walker to help off-load a little of her care.

Mark Your Calendars for Upcoming Meetings

National Student Conclave
October 21-23, 2011 • Minneapolis, MN

CSM 2012
February 8-11, 2012
Chicago, IL

Annual Conference: PT 2012
June 6-9, 2012
Tampa, FL

- Serves as your base residency curriculum or supplements your existing material.
- Informative supplements for residency instructors and residents.
- Online examinations included.

APTA
American Physical Therapy Association

CLINICAL ORTHOPAEDIC RESIDENCY CURRICULUM PACKAGE

The Orthopaedic Section of the American Physical Therapy Association is proud to offer a didactic residency curriculum that will meet all aspects of the Orthopaedic Description of Specialty Practice (DSP).

This didactic curriculum can stand alone as the foundation for any orthopaedic residency or supplement your existing educational material.

Courses included in this package:

- *Current Concepts of Orthopaedic Physical Therapy, 2nd Edition*
- *Postoperative Management of Orthopaedic Surgeries*
- *Pharmacology*
- *Diagnostic Imaging in Physical Therapy*
- *Clinical Applications for Orthopaedic Basic Science*

This complete package, including all supplemental material and online examinations for competency, is offered to Orthopaedic Section members at $400.00 USD*.

*You must provide verification that you are currently enrolled in a credentialed residency program or developing a credentialed program to be eligible for program materials. The course will be offered to nonOrthopaedic Section members for a fee of $800.00.

For more information, contact us at:
800/444-3982
or visit our Web site at:
www.orthopt.org.

Orthopaedic Physical Therapy Practice

Instructions to Authors

Christopher J. Hughes, PT, PhD, OCS, Editor
Sharon L. Klinski, Managing Editor

1. *Orthopaedic Physical Therapy Practice (OPTP)* serves as a publication option for articles pertaining to clinical practice as well as governance of the orthopaedic section and corresponding Special Interest Groups (SIG). Articles describing treatment techniques as well as case studies, small sample studies and reviews of literature are acceptable. Papers on new and innovative technologies will also be considered for publication. Language and format of articles should be consistent with the *Guide to Physical Therapist Practice*. SIG authors must adhere to the 12 page limit when submitting articles as part of SIG report.

2. Manuscripts should be reports of personal experiences and written as such. Though suggested reading lists are welcomed, references should otherwise be kept to a minimum with the exception of reviews of literature. All authors are required to sign a consent form indicating verification of original work and this form must accompany your work at the time of submission. This form can be found on the Orthopaedic section website (www.orthopt.org) under the Orthopaedic Physical Therapy Practice link. Authors are solely responsible for proper citation of work and avoiding any issues with copyright infringement related to writing or use of images or figures. For more information on plagiarism authors may find the following resources helpful:
http://www.plagiarism.org/
http://www.turnitin.com/research_site/e_home.html

3. Presenting research: OPTP welcomes traditional experimental research studies as well as case reports. Studies involving human subjects must have successfully met the requirements and been approved through an institutional review board. Case reports of involving 3 or less subjects must follow HIPAA guidelines in protecting the privacy of subjects. For more information access the following:
http://www.hhs.gov/ocr/hipaa/

4. **Article Review Process**
Authors will be immediately notified of receipt of document by managing editor. All initial reviews are done by the editor, managing editor, and also possibly a member of the advisory council of OP. A schematic of the review process is attached. Articles are reviewed in the order in which they are received. You will receive a confirmation of your submission and will be updated on the status of your work as we complete the review process. A schematic of the review process is attached.

5. **Manuscript Preparation Guidelines**
Title Page - include the author's name, degree, title, current place of work or affiliation, corresponding address, phone and FAX numbers, and email address.

Abstract - Abstract of 150 words or less using double space format. Abstracts at minimum should include the following headings: Background and Purpose, Methods, Findings, Clinical Relevance
Key words should also be listed after the abstract.

Format - text should be a minimum of 12 pages double-spaced, use a 12-point font; margins should be 1 inch on each side. Headings should be formatted as follows:
MAIN HEADING
Secondary Heading
Tertiary heading

Citation of Reference List - references should be numbered sequentially as they appear in the text and should correspond to the superscript number in the text. Do not repeat the same reference using a different number in the reference list. Only references cited in the paper should be listed.

Journal Articles

16. Ferguson CT, Cherniack RM. Current concepts: management of COPD. *N Engl J Med*. 1993;328:1017-1022.
17. Rueben DB, Siu AL. An objective measure of physical function of elderly outpatients (The Physical Performance Test). *J Am Geriatri Soc*. 990;38:1105-1112.

Books

18. Steindler A. *Kinesiology of the Human Body Under Normal and Pathological Conditions*. Springfield, Ill: Charles C. Thomas; 1995:63-64.

Abbreviate United States state and territory names as specified in the *American Medical Association Manual of Style*—NOT according to the United States Postal Service abbreviations.

Editor(s) as author:

19. Scully RM, Barnes ML, eds. *Physical Therapy*. Philadelphia, Pa: JB Lippincott Co; 1989:83-98.

Reference to part of a book:

20. Goodman CC. The endocrine and metabolic systems. IN: Goodman CC, Boissonault WG, eds. *Pathology: Implications for the Physical Therapist*. Philadelphia, Pa: WB Saunders; 1997.

Tables - provide tables to present information more clearly and concisely than if presented in the text. Table titles are usually written as phrases. They are capitalized in title case and do not employ terminal punctuation:

Table 1. Symptoms of Chronic Fatigue Syndrome

Reference to a Web site:
Information on Total Knee Replacements. American Academy of Orthopedic Surgeons. www.aaos.org/wordhtml/research/oainfo/OAinfo_knee_state. Accessed on September 5, 2005.

Format and Presentation of Figures, Graphics, and Tables

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Figure 2. Kinesthetic testing using an electronic inclinometer.

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- Legends to Figures. Type all legends on one page after the reference list and tables.

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