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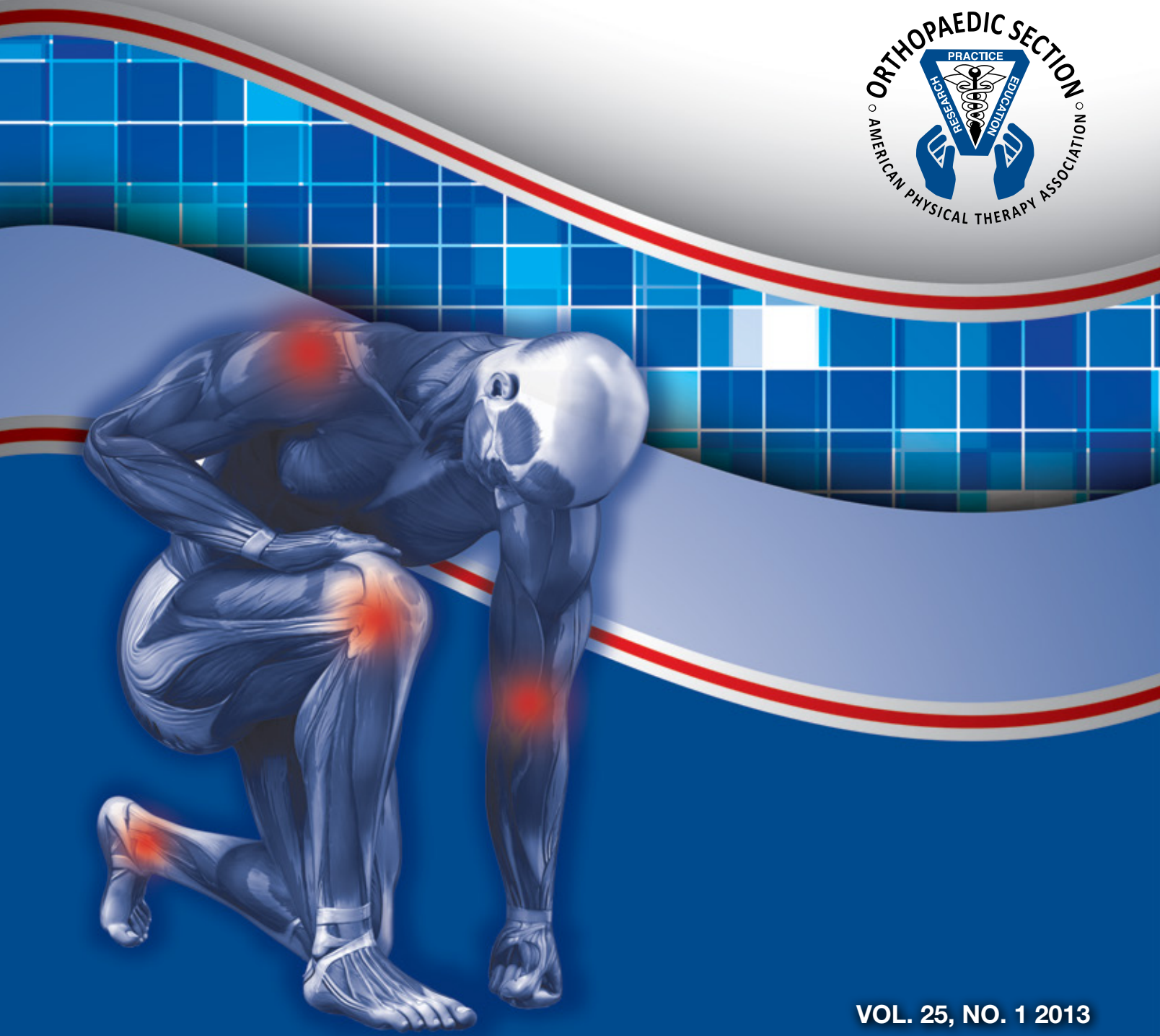

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The Effect of Shoulder Mobilization/ Manipulation on Increasing Range of Motion in Patients with Stiff Shoulders: A Systematic Review

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ABSTRACT

Background and Purpose: Shoulder stiffness, including adhesive capsulitis or frozen shoulder, is characterized by a decrease in shoulder range of motion. Adhesive capsulitis affects about 3% of the population, being most common in women between the ages of 40 and 70. This condition progresses in 4 stages and is considered a self-limiting condition that can last from 12 months to 42 months. Many treatments are used for adhesive capsulitis. Manipulation is often the treatment of choice even though there is a dearth of high level evidence to support it. In our literature search, we considered any skilled passive movements of the shoulder that were applied at varying speeds and amplitudes as a manipulation. The purpose of our systematic review of the literature was to determine the effects of shoulder manipulation on increasing range of motion in patients with stiff shoulders, compared to home based exercise programs. **Methods:** A literature search was performed using the following databases: Sports Discus, CINAHL, Cochrane, PEDro, Scopus, and Medline. Papers were selected based on the inclusion criteria of: primary diagnosis of idiopathic shoulder adhesive capsulitis, manipulation as a primary intervention, published between January 2000 and September 2011, and available in English. Exclusion criteria included: manipulation under anesthesia, shoulder stiffness as a result of injury, or surgery to the affected shoulder. **Findings:** Of the 280 papers identified from a multi database search only 5 satisfied the inclusion and exclusion criteria. Two papers were randomized controlled trials and 3 papers were cohort studies. Varied results were found as to whether adding manipulation to the exercise programs of patients presenting with adhesive capsulitis enhances treatment effectiveness or restores motion. **Conclusion:** Several studies suggest improvement of range of motion with this method of treatment, but lack true controls that would allow for distinction between benefits derived from treatment in comparison to the natural history of the disorder. **Clinical Relevance:** Based on the current literature it is not possible to discern whether manipulation in conjunction with a traditional exercise program leads to an increase range of motion in this population.

Key Words: adhesive capsulitis, manual therapy, physical therapy

INTRODUCTION

Shoulder stiffness develops for a variety of reasons. Stiffness is a hallmark symptom in adhesive capsulitis, often referred to as frozen shoulder. Adhesive capsulitis is associated with joint capsule contraction and adherence of the glenohumeral joint to the humeral head; and is characterized by a decrease in shoulder range of motion (ROM) and shoulder pain that is often described as a poorly localized, deep ache.[1] The pathophysiology of adhesive capsulitis is poorly understood, but evidence points to capsular hyperplasia, fibrosis, and autoimmunity as having possible roles.[1] Adhesive capsulitis affects about 3% of the general population, with women between the ages of 40 and 70 being the most affected.[1] The nondominant hand is more commonly affected, and a person previously affected with adhesive capsulitis has an increased risk of developing the condition on the contralateral side.[1]

> ***It is unclear whether mobilization/manipulation is beneficial in the treatment of adhesive capsulitis.***

Diagnosis can be difficult considering many intrinsic and extrinsic factors that can affect shoulder stiffness and pain, but adhesive capsulitis is generally classified as either primary or secondary. Primary or idiopathic classification occurs when inflammation, fibrosis, pain, and decreased ROM are present without any pathological precursor. The secondary classification occurs when adhesive capsulitis developed from prolonged immobilization of the glenohumeral joint due to disease or previous pathology, such as postsurgical pain, bicep tenodesis, acromioclavicular pathology, thyroid disease, diabetes, or multiple other pathologies.[2]

Nevaiser and Hannafin[2] described the progression of adhesive capsulitis in 4 stages, with the process lasting approximately 12 to 42 months. Stage one is characterized by broad pain around the deltoid insertion, night pain, empty end feel, and decreased active ROM; typically lasting less than 3 months. Loss of glenohumeral external and internal rotation with full rotator cuff strength is also indicative of early adhesive capsulitis stages.[2,3] Other physical signs are common, but are associated with multiple shoulder pathologies making them nondiscriminatory. Stage two, or the freezing stage, involves more capsular contracture; hypervascular synovitis; scaring; further flexion, abduction, and rotation limitations; and increased pain.[2,3] Stage three, or the frozen stage, involves severe stiffness in all planes with pain at end ranges. Range of motion is not improved in stage three with anesthetic injection as it can be in earlier stages. Stage three typically lasts 9-15 months.[2,3] Stage four, or the thawing stage, is characterized by a gradual increase in ROM, decreased pain, capsular remodeling, and restoration of function.[3] The last stage can last between 5 to 26 months, and the level of recov-

ered functional ability will vary between patients.[3]

A wide range of treatments for adhesive capsulitis currently exist including: oral and injected pharmacological agents, physical therapy, surgical procedures, and manipulations under anesthesia.[2] Many pharmacological agents have been shown to provide temporary pain relief, and injections have shown transient improvement in functional mobility during early stages; but no agent has provided long term improvements.[2] Studies have shown surgical interventions, including manipulation under anesthesia, arthroscopy, and open release procedures provide significant immediate pain relief and improved function, but have not shown greater improvement in long term benefit compared to noninvasive treatments.[2] Physical therapy remains the treatment of choice even though there is a dearth of high level evidence to support it. Physical therapy may include interventions such as hydrotherapy, iontophoresis, cryotherapy, ultrasound, TENS, passive ROM, manipulation, continuous passive motion, and home exercise programs among others.[2] Goals for physical therapy treatment focus on reducing inflammation, preventing or restoring ROM and function, decreasing pain, and enhancing patient education.[2] However, the most effective interventions of physical therapy are inconclusive due to mixed results in the literature.

Adhesive capsulitis is considered a self-limiting condition, although the process can last anywhere from 12 months to 42 months and may consist of severe pain, decreased ROM, and a decrease in functional abilities. About 10% of patients with frozen shoulder will not make a full recovery and will experience long-term problems such as pain and functional loss.[4] With little evidence to support the most common treatments for adhesive capsulitis, including physical therapy with manipulation, the appropriate management for this condition remains unclear.

Manual therapy may be an effective intervention for this dysfunction. According to the *Guide to Physical Therapist Practice*,[5] mobilization/manipulation refers to skilled passive movements of a joint that are applied at varying speeds and amplitudes, including a small-amplitude/high-velocity therapeutic movement. The purpose of our systematic review of the literature was to determine the effects of shoulder mobilization/manipulation and home exercises on increasing ROM in patients with stiff shoulders, compared to home-based exercise programs alone.

METHODS

Data Sources and Searches

A literature search was performed in August of 2011 using CINAHL, the Cochrane Library, Medline, PEDro, Scopus, and Sports Discus. The search strategy to identify relevant studies was based on the PICO model--population, intervention, comparison, and outcome (measures). The population search terms used were: shoulder, glenohumeral joint, adhesive capsulitis, frozen shoulder, stiffness, and insidious onset. The intervention search terms included physical therapy, manual therapy, manipulation, and mobilization. No search terms were used in the comparison group. For the outcome group, search terms consisted of ROM, passive ROM, and function. Terms for population, intervention, and outcomes were combined with "OR." Inter-group terms were combined using the search term "AND." Citations were stored and organized using RefWorks.[6]

Study Selection

Inclusion criteria:

1. Subjects had a primary diagnosis of idiopathic shoulder adhesive capsulitis.
2. Use of manual mobilization/manipulation as a primary intervention.
3. Papers were published between January 2001 and September 2011.
4. The paper had to be available in the English language.

Exclusion criteria:

1. Manipulation was performed under anesthesia.
2. Adhesive capsulitis was a result of trauma or injury.
3. Surgical interventions were performed on the affected shoulder.

Article Assessment

Seven reviewers discussed and evaluated the 5 papers that met the selection criteria. The paper discussions were guided by an outline based on Portney and Watkins.[7] One article was reviewed each week for 5 weeks. Paper discussions were led by a primary reviewer and supported by a secondary reviewer. These roles rotated among the group weekly. The primary and secondary reviewers met prior to each group meeting for a preliminary discussion about the paper and its ratings. Papers during the group meeting were then rated using the Philadelphia Panel Grading Scale.[8] Any disagreements in rating were discussed as a group and a final consensus was established.

RESULTS

The initial search of all 6 databases yielded 382 papers. Two hundred and eighty papers remained once duplicates were removed. The remaining papers were assessed based on title, abstract, and inclusion and exclusion criteria, yielding 5 papers that examined the effectiveness of manipulation techniques on shoulders with adhesive capsulitis. The results of the literature search are illustrated in Figure 1. Two trials[9,10] were randomized controlled trials and 3 trials were cohort studies.[11-13]

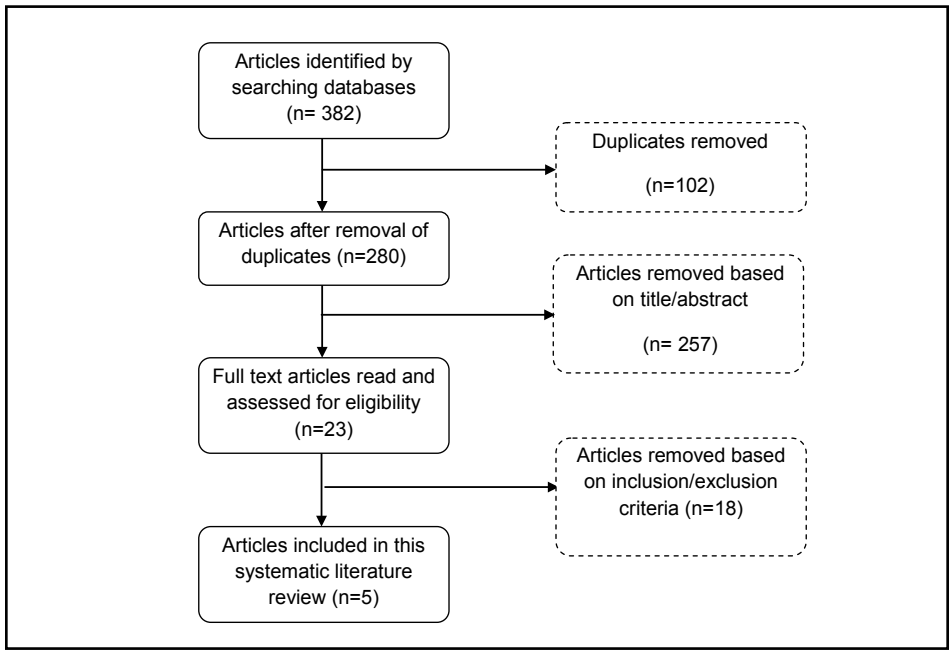

Figure 1. Flow chart of the literature search.

DISCUSSION

The aim of this review was to determine if manipulation is an effective intervention option in addition to a home exercise program when treating patients with insidious onset adhesive capsulitis. Five clinical trials with a total of 325 subjects were included in this review. Patients included in these studies were diagnosed with unilateral adhesive capsulitis and demonstrated decreased active and passive ROM of the glenohumeral joint.[9-13] Two studies defined decreased ROM as greater than 50% loss relative to the non-affected side.[11,13] In 4 of the 5 studies, patients were excluded if they recently had significant trauma to the affected arm.[10-13] Other common exclusion criteria included manipulation under anesthesia[12,13] and pre-existing neurological conditions.[10,12,13]

The primary outcome measure used throughout the 5 studies was glenohumeral ROM.[9-13] All but one study measured active ROM.[9,11,13] Johnson et al[12] also measured passive ROM, while Giler-Uysal and Kozanoglu[10] only measured passive ROM. Johnson et al[12] only completed measurements of abduction and external rotation, whereas all others measured glenohumeral ROM in all planes.[9-11,13] Shoulder pain was used as a secondary outcome measure in all studies.[9-13] Four of the 5 studies used a shoulder function measure, including the Shoulder Pain and Disability Index,[9] the Constant Score,[11] the Shoulder Rating Questionnaire/Shoulder Disability Questionnaire,[13] and the 5 Item Self Assessment Function Questionnaire.[12]

For the purposes of this systematic review, as defined by the *Guide to Physical Therapist Practice*, mobilization/manipulation was considered to be a skilled passive movement of a joint applied at varying speeds and amplitudes.[5] The authors of all 5 studies used manipulation with the goal to increase glenohumeral ROM.[9-13] Three studies compared an experimental group receiving mobilization/manipulation to a control group who received exercise and advice alone.[9-11] Guler-Uysal and Kozanoglu[10] used a control that underwent heating modalities.

Chen et al[9] had an experimental group that received low velocity passive joint mobilizations of the glenohumeral, sternoclavicular, and acromioclavicular joints in addition to exercises aimed at restoring neuromuscular control and advice on pain avoidance. At one and 6 month follow ups, this group demonstrated no significant improvements in shoulder ROM compared to the control group who was only given exercises and movement advice.[9] Diercks and Stevens[11] used a quasi-experimental design with a successive cohort to compare use of passive mobilization and stretching to the control group receiving only movement advice and exercise. They found no significant differences in active ROM between groups in shoulder ROM at each 3 month follow up over a 2-year period.[11] However, due to the lack of true randomization, internal validity of this study was a concern. The final study including a control group, Guler-Uysal and Kozanoglu, used a Cyriax approach including deep friction massage and manipulation as compared to a control group receiving short wave diathermy and hot pack wraps (considered standard of care). Both groups were instructed to complete a home exercise program including active stretching and pendulum exercises.[10] Significant differences between the two groups for shoulder flexion, internal rotation, and external rotation were found in the first week of treatment in favor of the Cyriax group.

The two remaining studies each compared the effects of two different types of manipulations on shoulder ROM but lacked control groups. Johnson et al[12] compared anterior and posterior directed shoulder mobilizations, finding significantly more improvements in active external rotation ROM in the group receiving posterior mobilizations between 3 and 6 months of treatment. The authors focused on active external rotation ROM as their primary outcome measure because it is commonly the most restricted physiologic movement for patients with adhesive capsulitis.[12] Similarly, the subjects in the Vermeulen et al study[13] were divided into two groups--one receiving high-grade mobilization technique (HGMT) and the other low-grade mobilization techniques (LGMT).[13] All the subjects demonstrated significant improvement of shoulder ROM throughout all planes from their baseline.[13] Significant differences between groups in favor of HGMT were found at 3 months for passive abduction, and 12 months for passive abduction, passive external rotation, and active external rotation.[13] Due to the lack of a control group, it is difficult to determine whether favorable results were due to the intervention or the natural course of adhesive capsulitis.

The intention of this review was to evaluate differences in ROM outcomes between groups receiving manipulation and exercise compared to groups receiving exercise alone. This question was difficult to specifically assess due to the varying interventions used in the included studies. Two studies lacked a control group[12,13] and another included thermal modalities as a control,[10] therefore decreasing the applicability of the studies to our specific purpose. Varying definitions of manipulation were also used throughout the 5 studies reviewed. In addition, some studies did not clearly define the grade of manipulation used while others implemented techniques that normally would not be expected to increase ROM in a stiffness dominant disorder. Adhesive capsulitis is characterized by 4 stages of glenohumeral involvement. Consequently it was difficult to compare studies that used various treatment lengths that likely spanned different stages. Also, not all studies included both short term and long term follow up that would have been helpful in evaluating treatment effectiveness.

Future research should include using control groups to differentiate outcomes produced by manipulation from those caused by the natural history of adhesive capsulitis. The available research used in this review presents differing results as to whether adding manipulation to the exercise programs of patients presenting with adhesive capsulitis is an effective treatment option. Two studies suggested that manipulation has no added benefit for increasing ROM in patients with adhesive capsulitis.[9,11] Guler-Uysal and Kozanoglu[10] found a significant benefit to adding Cyriax based manipulations to exercise in order to increase shoulder ROM in the short term. The remaining two studies demonstrated improved ROM following treatment with manipulation but failed to include a control group.[12,13]

CONCLUSION

Adhesive capsulitis resulting in global loss of shoulder ROM is treated in many ways including pharmacologic agents, manipulations, and manipulation under anesthesia. The purpose of this review was to determine the effectiveness of manipulation in conjunction with a home exercise program to increase ROM in this population. Given the current literature, it is unclear if manipulation is beneficial in addition to exercise in the management of adhesive capsulitis. Recommendations for future research include using control groups receiving exercise alone and also assessing the effects of mobilization/manipulation, during specific stages of adhesive capsulitis.

CLINICAL RELEVANCE

Manipulation in the treatment of adhesive capsulitis may be of benefit to increase

ROM. Inconsistency regarding manipulation techniques, grades, and durations of the treatments make it difficult to recommend treatment parameters. Although manipulation is commonly used to treat adhesive capsulitis, there currently is not substantial research to support its use or disuse in addition to an exercise program for this population.

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Ceramic Fractures in Uncemented Hips

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ABSTRACT

Ceramics have many favourable properties such as hardness, wettability, and high compression strength, making them an attractive option for use as a bearing surface in total hip arthroplasty. Recent years have seen advances in the design and processing of ceramics, as well as advances in engineering of head-neck articulations and liner design. However, low fracture toughness and linear elastic behavior make ceramics susceptible to fracture under stress. We report a series of 3 cases from a district general hospital where patients suffered either a fractured head or liner and the subsequent findings at revision surgery.

Key Words: ceramic, fracture, hip replacement

INTRODUCTION

Pierre Boutin first introduced ceramics in orthopaedics in the early 1970s[1] in order to overcome the complications related to polyethylene causing wear debris resulting in osteolysis around the implant. Despite there being any problems with the original ceramic hip systems, laboratory experiments proved that ceramic was a safe material, well tolerated by the tissues, and produced very low quantities of wear particles. However, high costs in addition to their susceptibility to fracture has been the limiting factor in an expansion of ceramic use.[2]

In recent years there have been great advances in the way ceramics are manufactured with improvements in grain size (lower size and distribution), a higher density, and purity. Modern alumina ceramics are ideal materials for bearing surfaces. They are more resistant to scratch, abrasion, and third body wear (entrapped abrasive particles between primary bearing surfaces). Furthermore, ceramic is hydrophilic and wettable which results in decreased friction, high lubrication, and little or no adhesive wear.[3]

Although the mechanical properties of ceramics have improved during the last 3 decades, fracture of ceramic components can still occur.[3] Most of the reported ceramic fractures after total hip replacement using third-generation alumina-on-alumina articulation have involved the ceramic liner of "sandwich-type" acetabular components.[4,5]

Ceramic components have theoretical advantages compared with metal-alloy or polyethylene ones. Their polish and corrosion resistance allow for low-friction articulations with excellent wear characteristics. But ceramic is brittle, which makes it susceptible to fracture.

Several factors increase the risk of fracture. Trauma, an active patient, and even obesity may increase fracture risk by increasing the load across the joint surface.[6,7] Other factors to take into account are mechanical properties of the ceramics, implant design, and surgical techniques in implantation of the prosthesis.[7,8] Fracture of a ceramic femoral head is rare today,[6,7] but this complication can be disastrous, with a risk of further revision procedures. Our case series of 3 patients describes ceramic fractures of the femoral head and liner that occurred after months to years of excellent function. The combination of obesity and high friction at the articulation between the femoral head and the liner can result in displacement of the ceramic liner.

CASE 1

Mrs VH is a 63-year-old female (115 kg) who underwent a right ceramic on ceramic hydroxyapatite-ceramic (HAC) coated uncemented JRI (50 cup, 28 mm short head) total hip replacement (THR) in September 2005 for osteoarthritis. She was medically fit apart from hypertension and a previously done left sided HAC coated uncemented (28 mm head size 60 cup) THR (Nov 2004) and had made an uneventful recovery postoperatively (Figure 1).

In August 2009, as she walked up her garden path she felt a clicking noise in her hip and a sudden sensation described like an earthquake in her groin that spread down the anterior aspect of her leg accompanied by severe discomfort like she had never experienced before. She was transported to the emergency department in an ambulance where she was examined and had x-rays (Figure 2). These x-rays were normal, and she was then discharged back home via hospital ambulance a few hours later. Once home she was mainly bed bound but managed to take a few steps and described crunching sensations and grating with severe pain. She was readmitted to the hospital 48 hours later when she became stuck and unable to mobilise off the toilet. She was referred to orthopaedics where she was diagnosed as having a ceramic head fracture.

In August 2009, VH underwent a revision operation 8 days after admission in the supine position via a Hardinge approach. The intraoperative finding was a shattered femoral head. The hip joint was dry but full of ceramic debris and black staining. After a thorough debridement and lavage, the head was replaced with a 32 mm small head. The liner and cup were well fixed and not macroscopically scratched and were therefore not revised. She made a good postoperative recovery and was discharged on the third postoperative day with pain free functional range of motion. She has been seen at 3 months and remains well.

CASE 2

A 56-year-old fit gentleman (85kg) with osteoarthritis of the hip underwent a left uncemented JRI using the anterolateral Hardinge approach with a 28 size short head, ceramic on ceramic cup (54) with 3 screws, and a ceramic liner.

The early postoperative course was uneventful. The hip was well fixed and stable with a good range of movement, and no impingement at the 6 week outpatient check. He mobilised well and after one year he was able to play basketball again. After 18 months of excellent function, he suffered his first episode of severe pain. Whilst jumping up to reach the ball, he heard a clicking noise. This was accompanied with an excruciating sensation of pain. He was unable to continue playing, and found it too painful to weight bear. After a few days of rest, the pain eased off and he was able to mobilise with crutches. When he was examined and

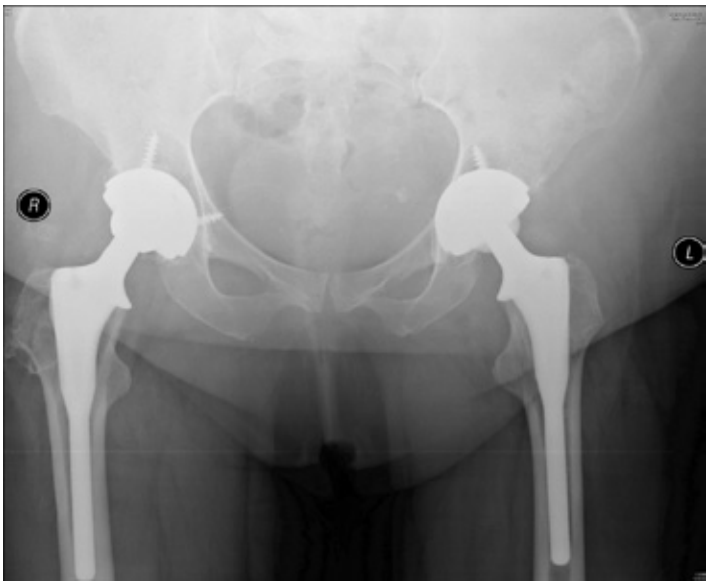

Figure 1. Bilateral total hip replacements.

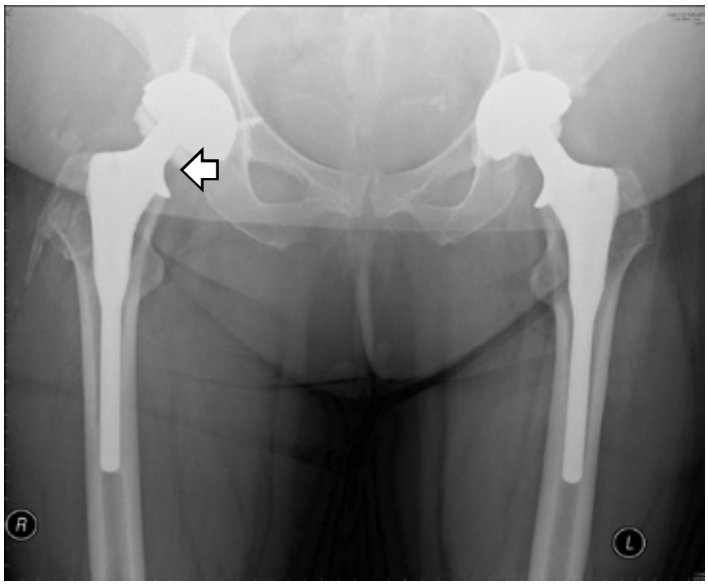

Figure 2. Ceramic head fracture (white arrow) right total hip replacement. Normal left hip replacement.

x-rayed in the clinic, he was found to have a ceramic head fracture (Figure 3). He underwent a revision procedure 10 days later.

During the operation, the hip was full of black coloured fluid and the liner was scratched but intact. There was no evidence of wear of the stem or cup but the head was shattered into multiple fragments. The metal shell and stem were not loose. After debridement and washouts with pulse lavage, the ceramic head was changed to a new 28 mm short head. The stem and liner were undisturbed and the patient recovered very well. He was discharged 2 days postoperatively as he was pain free and had good range of pain free motion.

CASE 3

A 53-year-old man who weighed 105 kg underwent a JRI uncemented THR in August 2009 for osteoarthritis of the hip. An anterolateral approach was used to place a ceramic on ceramic uncemented hip head size 28 mm and 56 mm cup with a ceramic insert. The hip was confirmed to be stable intraoperatively, with a good range of movement and without neck impingement in any direction. X-rays showed a well fixed cup and stem but retrospectively there was evidence that the liner had moved out of position (Figure 4). Postoperative progress was uneventful and he was discharged on day 4. He was clinically well at the 6 week postoperative check.

In December 2009 while he was lifting a heavy box, he felt something crack and heard a loud noise. He complained of severe pain in his hip with some grating sensations but managed to carry on mobilizing for short distances without bringing himself to the attention of a general practitioner or orthopaedic clinic. However, as he felt he was deteriorating with worsened pain and an inability to weight bear, he eventually referred himself to A&E in January 2010. He was referred to orthopaedics after undergoing an x-ray that revealed the liner was totally shattered (Figure 5).

He underwent a revision procedure two weeks later. The hip joint was dry when opened but the tissues were discoloured and the liner was broken into many pieces. The head was intact but scratched. The liner was shattered into small fragments but the stem did not show evidence of being scratched. There was no macroscopic wear of the head. The metallic shell and stem were not loose. During the surgery, after a thorough washout and debridement of the hip, the cup was revised using a 36/54 liner and a new 36 mm head. The patient made an uneventful in-hospital recovery and was discharged 3 days later. He remains well and is being followed up in the clinic. Review of the x-rays from the clinic at 6 weeks post op revealed that the liner had moved out of position during or soon after the original surgery.

DISCUSSION

Despite the widespread knowledge and awareness of the risk of fracture in ceramic hips, it is commonly acknowledged that the risk is low (2.2% Callaway).[9] A few studies have previously reported a fracture of the ceramic head.[11-13] Even fewer have reported a fracture of the ceramic acetabular liner.[12-14]

A total of 1200 HAC coated furlong total hip replacements have been performed in our district general hospital between 1995 and 2009 and the majority have been done by the senior author himself. All 3 cases reported above were revised by senior author, and were all ceramic on ceramic resulting in a fracture rate of 0.25%.

Our cases occurred over a 5-month period in 2009 and consisted of two head fractures and one fractured insert. In the first two cases, the surgeon used a 28 mm short head size – retrospectively felt to be the main cause for the complication. Previous work published also described a series of 5 ceramic fractures that occurred during normal daily activities in patients who had received a 28 mm short-neck ceramic head.[17] The fracture involved the thinnest circumferential portion of the head adjacent to the proximal edge of the head bore, with several vertical cracks extending from the circular crack to the lower edge of the head component. This was similar to our cases suggesting that the mechanism was a brittle fracture--characterized by rapid propagation of a crack with low energy release without substantial plastic deformation.

Previous work highlights the fact that the point of highest tensile hoop stress during impaction in the ceramic head is located at the superior corner of the bore. When using a short-neck taper, the contact area between the bore of ceramic head and the trunion of the femoral stem is high (Figure 6). The stress at the taper-bore interface is reduced with a short-neck femoral head. However, the distance between the corner of the bore

Figure 3. Left ceramic head fracture.

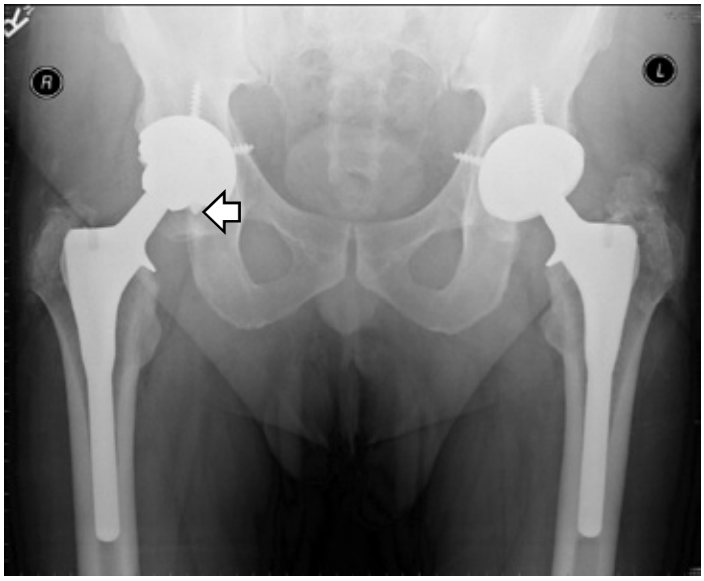

Figure 4. Arrow pointing to misseated liner.

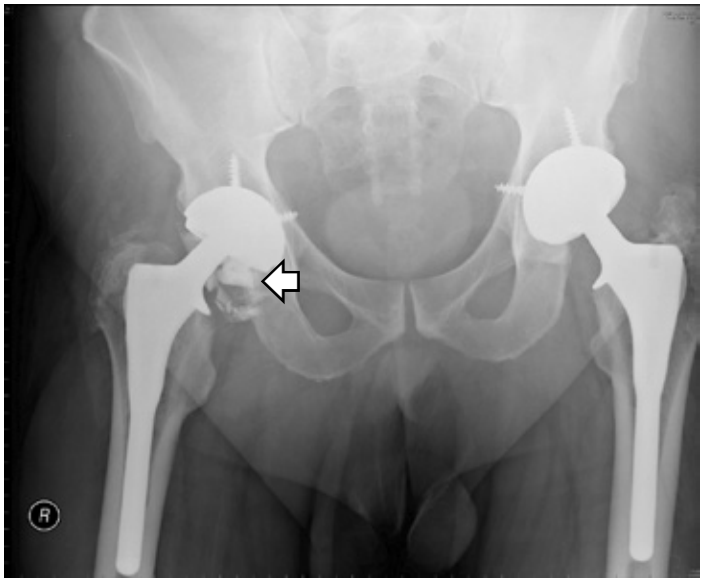

Figure 5. Right ceramic liner fracture.

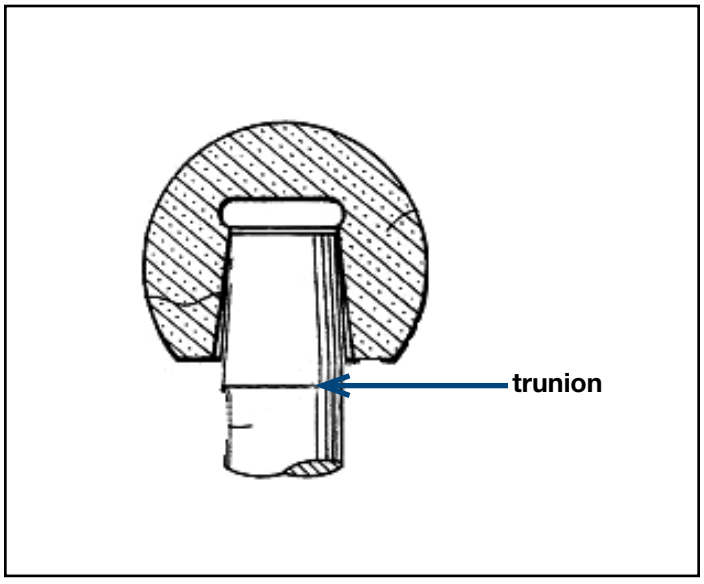

Figure 6. Location of trunion.

and the surface of the head is shortest for short-neck femoral components (2.4 mm). It is greater for medium-neck components (3.9 mm), and greatest for long-neck components (6.3 mm).[2]

With regard to Case 3, the most probable reason was a misplaced liner. A tilted liner results in 12 times greater stress in ceramics.[12,13] Neck-liner impingement and head subluxation results in high contact pressure on the opposite side. This causes abnormal loading of the insert in certain areas resulting in high stress and catastrophic failure of the liner. The ongoing third body wear (which is the result of ceramic particles rubbing against the articulating head and liner) helps to propagate the fracture.

McCarthy and Halawa[15] reported two cases of ceramic liner fragmentation caused by inappropriate liner tilting during surgery and recently, Popescu et al[16] reported a ceramic liner fracture caused by a slightly retroverted cup position that caused impingement between the femoral stem and the insert rim.

We are aware of only a few cases of ceramic hip fractures that have been reported after total hip arthroplasty with use of third-generation ceramic-on-ceramic components. One was a traumatic fracture that occurred following a motor-vehicle accident[19] and others occurred in association with sandwich-type ceramic liner fractures.[20]

Several factors may increase the risk of failure of the ceramic-on-ceramic arthroplasty. Increased weight and activity of the patient may increase the risk of failure by increasing the load across the joint. In our patients VH and AP were certainly overweight and case 3 also had the added effect of lifting a heavy box and then slipping on the ice. We did not change acetabular liner or femoral stem in the two cases of head fracture. This was because there was no damage to the trunion/taper of the femoral stem and only few minor scratches on the ceramic liner. In the case of the fractured acetabular liner, both components were replaced with ceramic on ceramic because the head was deeply scratched against the metal acetabular shell. The senior author feels that putting patients on crutches, nonweight bearing soon after a fracture of the ceramic head saves acetabular liners and the trunion from deep scratches, while superficial scratches heal as both metal and ceramic have self healing properties for superficial scratches.

Although all our cases were ceramic on ceramic, we believe that in cases where the insert is a poly this must be changed at revision as they extremely quickly wear seen secondary to a sandpaper effect from the ceramic dust from the fracture that can never be washed away even with large amounts of irrigation.

SUMMARY

In summary, our two cases of head fracture happened because of a manufacturing and or technical design of using a short head as described above, while the third case of an acetabular liner fracture was secondary to misplacement resulting in abnormally high loads and wear causing catastrophic failure.

The recognition of symptoms in such patients is highly important as it is only when one hears the description of pain and the feeling the fracture creates within the patient that a practitioner might realize the need for the patient to be reassessed clinically and sent for x-ray. Moreover if a patient is failing to progress after surgery, or has a fall, it is important for the practitioner to have a high suspicion of abnormal loading from eg, a misseated liner and place the patient on crutches until assessed surgically. Prompt recognition might help to avoid deeper damage to the components.

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Use of Mirror Visual Feedback in the Treatment of Complex Regional Pain Syndrome after Ankle ORIF: A Case Report

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ABSTRACT

Background and Purpose: Complex regional pain syndrome (CRPS) is a disabling condition and is a challenge for therapists to treat. The purpose of this case report is to describe the examination and use of mirror visual feedback as part of treatment for a patient with CRPS of the lower extremity following open reduction internal fixation. **Case Description:** A 51-year-old male with CPRS was seen in physical therapy after undergoing open reduction internal fixation of the ankle. Impairments included edema, restricted range of motion, and sympathetic dysfunction of the foot and ankle. **Methods:** Intervention included desensitization training, TENS, contrast baths, and the use of a mirror visual feedback program. **Findings:** The patient had a decrease in edema, increased range of motion and functional mobility, and reported decreased pain levels. **Clinical Relevance:** This case report supports the use of traditional physical therapy interventions plus mirror visual feedback in treatment of a patient with CRPS after open reduction internal fixation of the ankle.

Key Words: reflex sympathetic dystrophy, neuroplasticity, visual input, cortical reorganization, desensitization

BACKGROUND AND PURPOSE

Complex regional pain syndrome (CRPS) is a disabling condition consisting of burning pain, heightened pain sensation with normally nonpainful stimulation, motor disturbances such as weakness, tremor, and muscle spasm, as well as sympathetic dysfunction such as changes in vascular tone, temperature, and sweating. Trophic changes in the skin, nails, or hair pattern may also occur, as well as limb swelling and stiffness. The onset of CRPS is often preceded by trauma or a surgical procedure, or in some cases, by no clear precipitating event. Two types of CRPS have been identified as separate diagnoses: Type 1 occurring with no neural damage, and Type 2 with pain present with associated nervous system injuries such as a lesion or a tumor.[1,2] A study performed in the Netherlands estimated the incidence of CRPS to be 26.2 per 100,000 person years, with females having over 3 times higher ratios than males. The upper extremity is affected more frequently than the lower extremity, and 44% of cases are preceded by a fracture.[3] A study investigating the incidence of CRPS in a rural region of the United States reported a much lower rate of 5.5 per person years at risk, and a prevalence rate of 20.6 per 100,000 persons.[4]

Customary treatment of CRPS includes strength and flexibility training, gait training, postural correction, manual soft tissue techniques, desensitization techniques, contrast baths, electrostimulation modalities including transcutaneous electrical nerve stimulation (TENS), and ultrasound.[2,5-7] Additionally, scrubbing/loading programs are used in therapy clinics. Scrubbing stimulates large fiber receptors by repetitive back and forth motions in a weight-bearing position, whereas the weight-loading technique consists of carrying small objects in the hand, or weight bearing on the lower extremities.[2,6] Medication, including corticosteroids, gabapentin, nonsteroidal anti-inflammatory drugs, and opioids, are reported to be effective in the treatment of CPRS, but few have been tested in double-blind, randomized, controlled trials.[2,6] The purpose of this case report is to describe the management of a patient with CRPS after open reduction internal fixation of the ankle using traditional physical therapy interventions plus mirror visual feedback.

Complex regional pain syndrome is often compared to referred sensations, or phantom limb pain, described by individuals with amputations, in which a vivid presence of the limb and severe intractable pain is present.[8] Simply, pain arises due to a mismatch between motor output and proprioception feedback; the parietal lobes receive no input from the amputated limb, creating a painful sensation.[1] In the early 1990s, two experiments were performed to explore the nature of phantom limb pain, with the results paving the way for the discovery of mirror visual feedback.[8] Ramachandran[9] proposed a theoretical basis for CRPS based on neuroplasticity of neural connections and changes. For example, after amputation of an arm, tactile stimulation to the face will often evoke localized sensations of the phantom fingers and hand. This is a result of the sensory input from the face skin not only activating the face area of the somatosensory cortex, but also invading the adjacent hand cortex that is denervated.[8,9] In phantom limb pain, sensory discrimination training reduces pain, increases sensory acuity, and normalizes cortical reorganization.[1,10]

Mirror visual feedback has been studied in the treatment of phantom limb pain to decrease symptoms including pain, spasms, and phantom paralysis.[9,11] In a normal functional nervous system, the motor commands sent from the prefrontal and frontal cortex of the brain to clench the hand are diminished by proprioceptive feedback. However, with amputated limbs, this decrease is not able to occur, resulting in an increase in motor output. The visual input from the mirror may act to interrupt this loop.[9,12]

Chan et al[13] completed a randomized controlled trial of mirror therapy's impact on decreased pain in lower extremity amputees. The authors hypothesized that the decrease found in their study was due to either activation of the mirror neurons in the hemisphere of the brain that is contralateral to the amputated limb, or reduction of activity of the systems that perceive protopathic pain.

Brain imaging studies have been used to study the decrease in phantom limb pain with mirror visual feedback, revealing that the plastic changes that occur with amputation may be partially reversed resulting in a decrease in pain. This information suggests that the use of mirror visual feedback may influence long-term cortical reorganization of brain maps.[8] Other functional magnetic resonance imaging (fMRI) data suggests the mirror activity activates visual memory systems of the brain.[14]

Mirror therapy has been successful in the treatment of hemiparesis after stroke.[15] The

theoretical basis of this treatment is also centered in the neuroplasticity of the brain, but since a stroke involves damage to the central nervous system, it will not be discussed further here.

Studies of intractable pain conditions and impaired motor function responding positively to mirror visual feedback led to further investigations in the treatment of CRPS.[1,16] McCabe at al[17] hypothesized that the pain associated with CRPS is a result of a breakdown in central sensory processing, a mismatch of motor intention and sensory feedback, and that use of symmetrical movement feedback from the mirror re-establishes normal processing, thus decreasing pain and stiffness in the affected limb. Earlier studies examining mirror visual feedback in the treatment of CRPS showed the treatment led to significant relief of pain especially in the early stages of the syndrome, and a positive correlation was reported between the frequency of the mirror therapy and the duration of the pain-free time.[1,18] Not only was pain reduction seen in the patients, skin temperature change was also seen, an objective measurement that can't be biased by the patient.[8] Additional studies have examined the efficacy of a graded motor imagery program, including mirror visual feedback in treatment of chronic CRPS. The results suggested that the cortical activation induced by motor imagery program was a result of "training the brain" and reversing the disuse of the involved limb.[16] A second study examined imagery in treatment of chronic CRPS and concluded that tactile performance testing was improved with visual input, with results lasting up to two days.[10]

The true mechanism of how mirror visual feedback therapy works in the treatment of CRPS and its overall affects are not fully understood due to the limited number of clinical trials. Limited data exists on who would or would not benefit from mirror visual feedback, as well as specific protocols for treatment plans and durations.[14] The few clinical trials have addressed upper body treatment, with limited examination of lower body treatment. This may be expected, as upper body symptoms are more prevalent than lower body symptoms.

CASE DESCRIPTION

Examination

JC is a 51-year-old white male who underwent a 14-day delayed open reduction internal fixation (ORIF) for a transverse fracture of the left medial malleolus with lateral displacement and a probable syndesmotic injury. In the surgical recovery room, he complained of excessive pain in his left lower limb, and was discharged home with pain medication. As his recovery at home ensued, he began to note a progressive increase in pain and the beginning of a purplish discoloration in his left foot and ankle. He was not able to sleep with the bed sheet on his left limb as the tactile reaction would cause an increase in pain. One month following surgery, the surgeon diagnosed him with CRPS. He was then prescribed Neurontin, and referred to outpatient physical therapy for a desensitization program.

JC lived alone in a single level home with 3 steps with one handrail to enter his home. He was employed full time as a mental health worker, with job duties requiring prolonged desk work with intermittent standing and walking. Following surgery, he was placed on temporary disability until his pain and mobility improved. Prior to the injury, he was independent with ambulation, household activities, and activities of daily living. He reported that he enjoyed seasonal recreational hiking and outdoor activities during the summer months. His past medical history is significant for hypertension.

At the initial physical therapy session, the patient gave a localized pain response of 6/10 on the visual analog scale (VAS), at the anterior aspect of the left foot and ankle, and complained of numbness and tingling throughout the entire left foot. He reported an increase in pain with his left lower limb in the dependent position and at times without provocation. He reported an impaired sleep pattern, sleeping only one to two consecutive hours without waking due to left lower limb pain.

Tests and Measures

Integumentary system

Upon visual inspection, the left foot and ankle were deep-purple in color, with healed surgical incisions at the medial and lateral malleoli. The medial incision was two inches in length, the lateral incision one inch in length. At the initial physical therapy session one month postsurgery, Steri-strips were still present over the healed incisions and dried exudate present at both locations. The Steri-strips were removed, and sterile water and forceps were used to clean the incision.

Range of motion

Active ankle range of motion (ROM) was measured with a goniometer and the patient was placed in a supine position as described by Norkin and White.[19(pp154-161)] Documentation followed American Medical Association guidelines.[19(p30)] Range of motion measurements at the foot and ankle using a universal goniometer have been reported to have good intratester reliability.[20,21] Right ankle dorsiflexion was 8°, plantar flexion 25°, and the left ankle dorsiflexion lacked 9° from neutral; plantar flexion was 54°. Inversion and eversion measurements were deferred due to pain.

Circumferential measurements

Circumferential edema measurements were taken using a flexible nonstretch tape measure at predetermined distances from the medial malleolus. Use of a flexible tape measure for edema measurements at various distances from anatomical landmarks has been reported to be reliable and valid.[22] The center of the left medial malleolus was palpated and marked as a reference point for the measurements. The initial circumferential measurement was taken at the left medial malleolus and documented as 30.5 cm. Similar measurements were taken 5 cm distal to the medial malleolus (29.2 cm), 5 cm superior to the medial malleolus (26.4 cm), and 10 cm superior to the medial malleolus (29.0 cm). Circumferential measurements were not taken of the right lower extremity.

Gait

The patient ambulated nonweight bearing on the left lower extremity while wearing a controlled ankle motion (CAM) walker boot, and using bilateral axillary crutches, per physician instructions. Additional functional testing was not performed.

Sensation and strength testing

Sensation was not formally assessed with instrumentation due to the patient's hypersensitivity to any palpation. Manual muscle testing was deferred to a future session due to significant limitation of active ROM of the ankle and the movement limitations indicated by his surgeon.

Prognosis

JC was in good health and very motivated to make a full recovery and return to work and his recreational activities. Attainment of goals following an ORIF of an ankle fracture is expected to be accomplished in 6 to 18 visits, however, with JC's concurrent medical conditions and surgical interventions, optimal functional outcomes would be expected in 3 to 6 months.[23]

The prognosis was determined to be good

and the expectation was that the patient would benefit from skilled physical therapy services, one to two times a week, with treatment consisting of one or a combination of the following: electrical stimulation, aquatic therapy, manual therapy, neuromuscular re-education, therapeutic exercise, hydrotherapy, other modalities as needed, and gait training.[2,5,6] Short and long term goals for JC's plan of care are shown in Table 1.

Intervention

At the initial visit, a desensitization program was initiated. The treatment program consisted of stimulating the painful area with a variety of textures, starting with the soft texture such as a cotton ball and progressing to more course materials such as denim, rice, and eventually vibration (Table 2). Desensitization programs have been used as part of a standard course of therapy in the treatment CRPS.[2,6] JC had limited tolerance to stimulation with a cotton ball, hence, his program was started at this baseline level. He was instructed to rub a cotton ball up and down the left foot and ankle for 10 consecutive minutes every hour at home. This was performed in a long sit position as he had poor tolerance to sitting with the limb in a dependent position.

Three days following his initial physical therapy visit, he reported compliance with the desensitization program hourly at home, as well as a decrease in medication use. Since he was independent with the desensitization program for home use, a TENS unit was introduced this session to further reduce the pain. The TENS unit has been widely used to reduce pain associated with CRPS by activating small (A delta and C) and large fibers (A beta) that would effectively "close the pain gate" and diminish the input to the spinal cord.[2,5,6,24] An EMPI Select TENS™ unit was used, selecting the preset treatment program for the wrist/hand, with a duration of 20 minutes. Two leads were used, with the four 2 inch x 2 inch electrode pads placed on the dorsum of the left foot and ankle.

Table 1. Short and Long-term Goals for JC's Plan of Care

Short-term goals (within 4-6 visits)
1. Reduce maximal left ankle pain to 5/10 on VAS.
2. Increase sleep pattern to 4 uninterrupted hours for four consecutive nights.
3. Establish a home desensitization program.
4. Decrease edema in left foot/ankle by a total of 1 cm.
Long-term goals (within 12-16 visits)
1. Reduce maximal left ankle pain to 2/10 on VAS.
2. Increase left ankle active dorsiflexion ROM to 5°.
3. Maximize community ambulation with least restrictive assistive device.
4. Establish an independent progressive home exercise program.
5. Decrease edema in left foot/ankle by a total of 2 cm.
6. Return to work at full status.

Table 2. Desensitization Program Used in the Clinic

Instructions: Begin with the texture that causes the least discomfort; rub the sensitive area for 10 minutes or until the area feels numb and no longer sensitive. Follow for 2 minutes with the next texture down on the list. In an hour, return to the same texture and rub as before. However, if this texture seems to cause no abnormal feelings, it is time to progress to a rougher texture. Do not return to the softer texture; continue to progress through the list until you complete it.

1. Fur/cotton
2. Flannel cloth
3. Cotton fabric
4. Denim fabric
5. Burlap
6. Raw peas or beans
7. Raw rice
8. Raw macaroni products
9. Metal: BBs, paper clips, back of a spoon
10. Tapping on the edge of a table
11. Vibration

On his third visit in the clinic, JC reported no change in his pain levels from the previous session with the TENS unit. Mirror visual feedback was implemented at this visit to reduce pain and increase voluntary movement. The protocol used by McCabe et al[17] in a pilot study was used as a guideline in establishing JC's program. He was positioned in long sitting on the plinth, due to an increase in discomfort with the limb in a dependent position, with a mirror placed between his lower limbs, with the right limb mirror image easily visible to him (Figure 1). JC was instructed to perform symmetrical active bilateral ankle dorsiflexion and plantar flexion within tolerable pain levels, while concentrating on the mirror image of his right foot and ankle, and visualizing this image as the movement of his left ankle. He performed this activity for 10 consecutive minutes. He was instructed to add the mirror therapy to his home program every one to two hours and not to exceed 10 minutes in duration for any one session in order to maintain concentration. To conclude the session, the desensitization program was progressed by having a cotton towel rubbed on the right lower limb (noninvolved) for 5 minutes while he visualized the mirror image, and then the towel was rubbed on both lower limbs for an additional 5 minutes while he again concentrated on the mirror image.

On his return visit, JC reported significantly less pain in his left lower limb after the previous session and he had been diligently incorporating the mirror visual feedback into his home program. The TENS unit was again used in the clinic with the same settings as the previous session. After the TENS treatment, a contrast bath, which has been found to be a useful modality in pain relief and in improving circulation in those with CRPS, was begun in the clinic in an attempt to attain any additional pain and edema reduction.[2,5,24] JC submerged his left foot and ankle in a container filled with 95° water for two minutes. At the end of two minutes, his foot was transferred to a second container filled with tolerable ice cold water for one minute. His foot was then returned to the warm water and the sequence continued for a total of 10 minutes. He was instructed to try this at home 3 times a day in addition to the desensitization program and mirror visual feedback program.

One session later, he reported no pain change with the contrast bath or the TENS unit. The TENS unit was discontinued from the plan of care due to the two unsuccess-

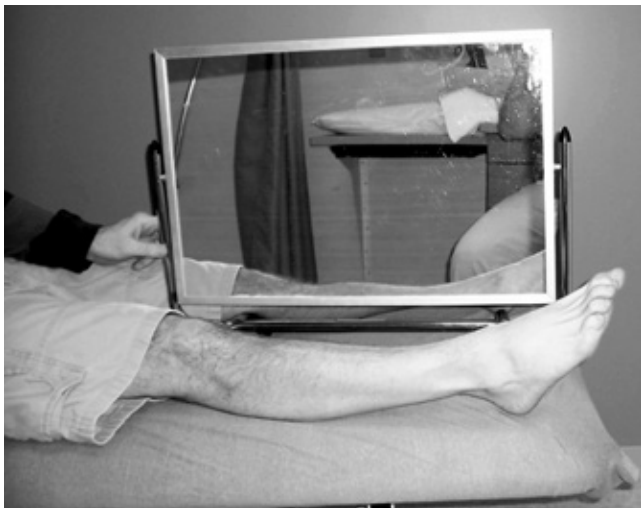

Figure 1. The patient and mirror placement for mirror visual feedback treatment performed in a long sitting position.

ful attempts at decreasing pain levels. The contrast bath was discontinued from the plan of care as well since he was progressing at home with the mirror and desensitization programs, and no further pain relief was reported with further use of the contrast bath. At home, he progressed to courser materials of the desensitization program protocol and placed his foot in a bowl of raw macaroni. His surgeon followed up with him during treatment and had cleared him to ambulate without an assistive device while wearing the CAM walker boot. The long sitting mirror visual feedback program in conjunction with the cotton towel desensitization with the mirror was continued until his sixth visit. During the sixth visit, he was experiencing decreased pain and reported tolerating a dependent position with less discomfort. His treatment positioning was therefore transitioned to a sitting position, with the mirror again placed between his legs so the mirror image of his right foot and ankle were easily visible (Figures 2 and 3). He was instructed on performing symmetrical ankle dorsiflexion, plantar flexion, inversion, and eversion for two sets of 20 repetitions with each motion, while concentrating on the image in the mirror. His home program was progressed to include these activities.

This plan of care was continued until his ninth visit. At this time the surgeon had cleared him to ambulate without the use of the CAM walker boot for physical therapy sessions only, and he was cleared to return to work the following day. During this session, he was able to progress to weight shifting activities while standing as well as gait training. Open chain and closed chain ankle strengthening and proprioception activities were added two sessions later to his home program. JC had also progressed to the last element of the desensitization program; using an electric razor to provide vibration to his left lower limb. The following session, he had worked one week without the use of his CAM walker boot, his home exercise program was finalized, and he was discharged from physical therapy services.

Outcomes

Functional status

At the time of discharge, JC was able to sleep a minimum of 6 consecutive hours without waking due to left foot pain. He was performing all his normal activities with the exception of hiking. At the conclusion of therapy sessions, JC was ambulating community distances without the CAM walker boot and without an assistive device. He ambulated with decreased heel strike on the left lower limb due to limited active ROM into dorsiflexion, and had difficulty with push off due to weakness with active plantar flexion.

Pain

JC experienced a decrease in pain after the mirror visual feedback program was initiated. As he returned to work his maximum pain levels did increase, but this was to be expected as he progressed to ambulation without the CAM walker boot full time, and his limb was also in a dependent position for approximately 50% of the work day. Physical therapy was not able to continue after return to work due to lack of insurance coverage. As detailed in Figure 4, JC's pain at the end of his physical therapy course was reported to be a 2/10 on the VAS at rest, and up to an intermittent 6/10 on the VAS, lasting up to 4 hours at a time. He was no longer taking any pain medications at the time of discharge.

Figure 2. The patient and mirror placement for mirror visual feedback treatment performed in a seated position.

Figure 3. An alternate view of the patient and mirror placement for treatment performed in a seated position.

Integumentary system

When the mirror visual feedback program was initiated, there was immediate progress in color change in the left foot and ankle. As the program advanced, improvement in color was seen on a weekly basis, and by the end of the 8 weeks of therapy, the left foot and ankle was near baseline status.

Range of motion

The active ROM of the left ankle dorsiflexion and plantar flexion increased throughout the course of therapy and is summarized in Figure 5.

Circumferential measurement

Overall, there was a substantial decrease in edema throughout the left foot and ankle (Table 3). When JC returned to work, he experienced a slight increase in edema at all measured locations due to increased time in the dependent position while at work.

DISCUSSION

Complex regional pain syndrome can be a debilitating pathology and is one of the most difficult challenges facing physical and occupational therapists. As the pain continues, functional use of the limb diminishes due to muscle atrophy and decreased ROM.[6] The patient in this case presented with hyperalgesia, edema, and skin temperature and color asymmetry, and was treated successfully with desensitization program incorporating mirror visual feedback to decrease pain and maximize his functional mobility.

The findings in this case report are similar to those previously reported.[1,8,18] The patient, in the early stages of CRPS, experienced a decrease in pain, especially when performing the therapy protocol every hour while at home. When he did return to work, he was not able to complete the mirror visual feedback program more than 3 times a day. There appeared to be a direct association between frequency of treatment and duration of the pain-free time.[1,16] In agreement with previous reports, the patient presented with changes in skin color, returning to a skin tone more comparable to his unaffected limb as therapy progressed.[8]

Alternate explanations may exist to explain the patient's increase in ROM, decreased edema, and change in color. One theory is that at his fourth visit he was able to bear weight on his left lower limb with the CAM walker boot. This weight bearing provided an inadvertent stress-loading element, which has successfully been used in the treatment of CRPS, to the therapy program.[2,6,7] A second alternative theory is that the Neurontin, which is frequently used in the treatment of CRPS, may have assisted in decreasing his symptoms, although the mechanism of action of the drug is not known.[6,25] A third explanation is simply that the ROM exercises performed while participating in the mirror visual feedback acted in decreasing his pain and improving ROM and function.[6]

Limitations

Limitations are evident in this case report. No functional questionnaire was used in the evaluation or throughout the course of treatment. The use of The Foot Function Index, which is a valid functional questionnaire in measuring the impact of foot pathology on pain, disability, and restrictions in activity, would have established a more objective

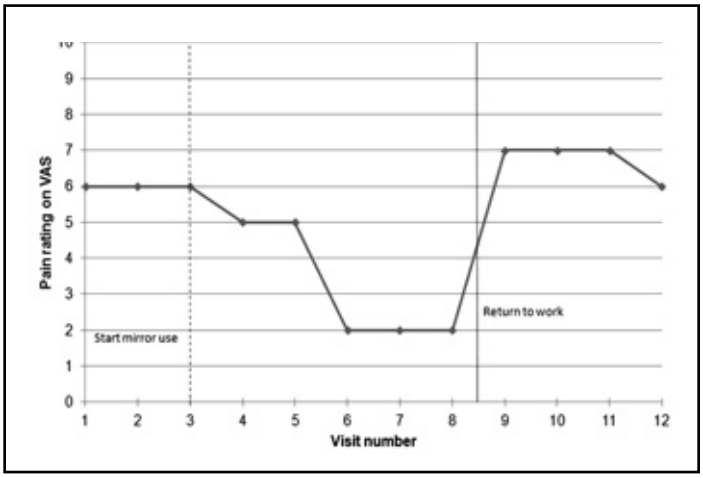

Figure 4. The maximum pain rating on VAS as reported on each therapy visit. The dotted vertical line depicts when the patient began the use of the mirror visual feedback program, and the solid vertical line represents when the patient returned to work.

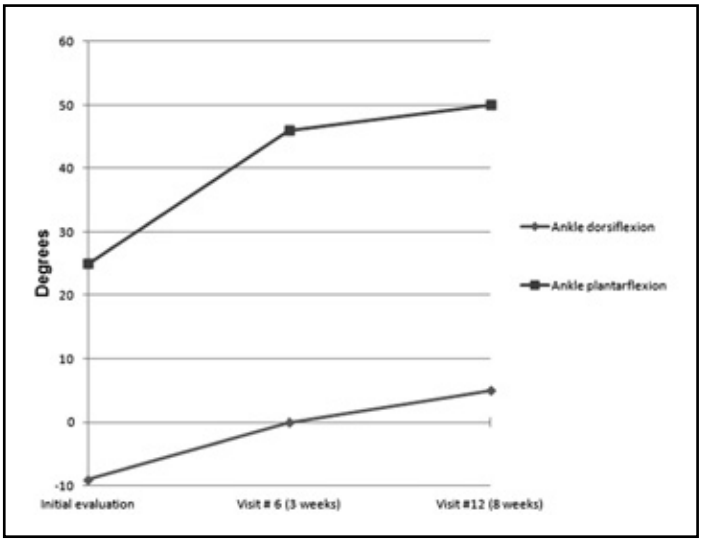

Figure 5. The left ankle AROM measured using a standard goniometer, as documented per the American Medical Association guidelines.[16(p30)]

Table 3. Circumferential Measurement as Measured with a Flexible Tape Measure

	Initial evaluation	Visit #3 (1 week)	Visit #9 (4 weeks)	Visit #12 (8 weeks)
Medial malleolus	30.5 cm	29.0 cm	29.1 cm	29.4 cm
5 cm below medial malleolus	29.2 cm	28.0 cm	26.7 cm	27.4 cm
5 cm above the medial malleolus	26.4 cm	25.4 cm	24.9 cm	25.2 cm
10 cm above the medial malleolus	29.0 cm	26.0 cm	25.6 cm	27.5 cm

measure of progress made with therapy.[26] Modalities including the TENS unit and the contrast bath were quickly discharged from the plan of care after one to two unsuccessful treatments. Although the patient was completing the desensitization program and mirror visual feedback program at home, these modalities may have been successful if trialed in the clinic again or at home for a longer period of time. Lastly, no long-term follow up was completed with the patient due to a lapse in insurance coverage.

Although mirror visual feedback therapy is thought to be unproven in the treatment of CRPS because of the unknown mechanism of action, the current literature on the subject is promising. A limited number of randomized control studies of mirror visual feedback and the treatment of CRPS have been performed to date, and additional studies are required to prove its efficacy. Further research is required to establish optimum frequency and duration of the treatment, as well as determining appropriate subjects for the therapy. Mirror visual feedback therapy has been suggested to accelerate the recovery of function in patients with varying neurological disorders such as hemiparesis after stroke, phantom limb pain, and CRPS; other neurological conditions such as Parkinson disease and trigeminal neuralgia should be explored.[8]

CONCLUSION

This case report describes the successful integration of mirror visual feedback in the treatment of CRPS after an ankle ORIF to decrease pain and edema, and increase ROM and functional mobility. Mirror visual feedback is a noninvasive, patient-directed, and inexpensive tool that may be considered in combination with preexisting rehabilitation methods in the treatment of CRPS.

ACKNOWLEDGEMENT

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Minimalist Shoes and Implications for the Runner

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ABSTRACT

Background: Our orthopaedic physical therapy practice has seen an increase in acute and often severe injuries such as metatarsal stress fractures or navicular drop correlating to minimalist shoe usage. We have been concerned with the current trend towards running footwear that is widely marketed but often equally inappropriate for many runners. **Purpose:** To raise awareness among our profession regarding minimalist footwear and its claims of helping runners run with less injury. And to raise awareness of the need for physical therapists who deal with runners to have a good understanding of the shoes in which our patients are exercising and the risk factors associated with running injury. **Methods:** We have tried to illustrate our objective(s) by discussing a recent case with relation to the use of minimalist footwear for running/marathon training. **Findings:** Minimalist shoes have been around for a very long time, but are only recently being mass marketed as an injury preventative type of footwear. We believe this to be incorrect and potentially dangerous. **Clinical Relevance:** Current marketing trends in running footwear are promoting footwear that is often inappropriate for many runners and can increase risk of injury. **Conclusion:** Our objective with this commentary is to raise awareness among our profession regarding minimalist footwear and its claims of helping runners reduce injuries.

Key Words: running, injury, orthotic

The novelty of running in minimalist shoes has been a growing trend in recent years. Some shoe companies make claims in the media and on their Web sites claiming that they "facilitate a natural, injury preventive running gait."[1] Most of these shoes offer significantly less support and are purported to alter the runner's stride so that they run more "efficiently." As a result of this widespread marketing towards minimalist shoes, many runners are purchasing these shoes in hopes of improving their running and eliminating their current running related injuries. Unfortunately, since many of these runners may already be injured or have existing altered running biomechanics, they may be causing or aggravating existing musculoskeletal impairments or biomechanical inefficiencies. In our clinic, we commonly see acute and often severe injuries such as metatarsal stress fractures or navicular drop correlating to minimalist shoe usage. Overuse injuries such as tendonitis and various muscle strains of the lower extremities have also been observed.

> ***We believe the data to date shows that minimalist shoes should NOT be marketed as a blanket solution for the general runner nor be chosen based only on foot type.***

One of the popular minimalist shoe manufacturers is Newton. The Newton[1] shoe is designed to promote a more "natural" way of running. In its attempt to promote a natural landing, most of the company's shoe designs have a forefoot posting that encourages the runner to land on their forefoot/midfoot. However, we have observed clinically that the forefoot posting creates a torsional fulcrum at the midfoot if the runner isn't biomechanically sound. The torsion appears to occur most notably during the stance phase of the runner's gait. The midfoot of the minimalist shoe has a space or an effective "gap" between the heel of the shoe and the higher forefoot posting. As the runner naturally moves through the pronation component during the stance phase of gait, "torsion" or twisting occurs and the midfoot collapses since, in this gap, there is no part of the shoe making contact with the ground. The unstable fulcrum at the midfoot combined with an underlying weakness or muscle imbalance can predispose a runner to an acute or repetitive stress injury. This torsion is amplified when the increased ground reaction forces of running are added.

A recent patient in our office illustrated this problem. JR is a 35-year-old male referred to physical therapy with complaints of severe pain in his left lateral shin. JR is a consistent runner, having previously completed two full marathons within the past 3 years. He reported that his symptoms began during mile 22 of his last full marathon. Although he finished the race, JR reported that his pain became progressively worse after its initial onset. When asked about any changes to his training or racing methods, he mentioned that he decided to run the race in the Newton minimalist shoes with Superfeet orthoses[2] in an attempt to improve his previous marathon time and reduce his risk for injury. JR carefully followed Newton's Web site tips on "adjusting to your running shoes"[1] when he initially transitioned into the new minimalist shoes. Prior to this transition, JR was running in Nike stability[3] shoes with Superfeet orthoses,[2] which he had purchased from the same store that later sold him the Newton shoes with Superfeet orthoses. JR originally purchased the stability shoes and orthoses after suffering an injury 10 months prior. At that time, after negative x-ray results, he was diagnosed with plantar fasciitis. The podiatrist's prescribed treatment was simply sending JR to this running store for Superfeet orthoses and a new pair of shoes. The store sold him the Nike stability shoes with Superfeet orthoses, and he reported having no problems while running in the stability shoes.

Shoe inspection (his minimalist shoes)

revealed mechanical breakdown of the left shoe's medial platform and upper into pronation (Figure 1). No visible changes or faults in the right shoe were observed. Current examination of his orthoses revealed breakdown of the medial side of the left orthotic at the arch. Also noted was a "crack" in the orthotic that was present at the platform where the most breakdown occurred (Figure 2). This finding was consistent with the region of breakdown described in the left shoe. There was no significant breakdown of the right or left sides of the stability shoe and there was no obvious medial deformity present in the shoe itself.

Physical examination of JR revealed moderate edema located in the left lateral ankle and foot. There was a palpable deficit in the left peroneus longus tendon, 6 inches proximal to the left lateral malleolus with the patient reporting a subjective pain level of 8/10. JR denied that this deficit was present prior to his most recent injury. These findings suggested a probable tear. No additional diagnostic imaging was completed at that time. He had a hypermobile subtalar joint toward overpronation observed during weight bearing. JR additionally reported difficulty with weight bearing activities such as walking, standing, transitional movements, as well as morning pain and stiffness getting out of bed. He demonstrated an antalgic gait pattern and was unable to functionally weight bear onto his first ray while performing a heel raise.

There is existing data indicating that one of the predictors of a future running injury is a prior running injury within the past year.[4] Moreover, the rate of injury has been shown to be higher with minimalist footwear in those runners who have transitioned from a more supportive shoe[5] and remains higher after their transition period with sustained usage than runners not using minimalist shoes.[6] We postulated that he was running asymptomatically while in the stability shoe because he had the adequate medial support he needed to manage his functional weakness. However, when transitioning into the minimalist shoe, we felt that the combination of this functional instability in his left lower extremity combined with an unsupportive shoe, led to the breakdown of the orthotic--which ultimately led to his running related injury. Examination of this patient's equipment/footwear was crucial to his assessment, guided treatment decisions, and contributed to the successful return of this patient to his running program.

In addition to proper equipment, focus was placed on correct running biomechanics to return the patient back to their sport safely and to encourage independent function. During the later stages of rehabilitation, sports specific exercises including plyometrics and stride development (eg, cadence and turnover) were also important components. JR was instructed in a return-to-training program as well as a graded injury-specific exercise progression. Upon discharge, JR was able to return to full function (including running) and he subsequently ran his personal best at his next half marathon. Addressing all of these issues combined with immediately getting him out of minimalist shoes, and into a more supportive shoe, was important in effectively managing this case.

After JR's injury, Newton shoes recently released a disclaimer on their Web site stating, "Pre-existing conditions or injuries may mean our shoes are not right for you. If you have an injury, a biomechanical issue, an anomaly or a predisposition to a particular type of injury, consult your physician, coach, or orthotics supplier before using Newton shoes."[1] This statement alone excludes the majority of the running population from safely running in Newton shoes. Injury rates are higher for both runners who transition to minimalist footwear[5,6] and for runners with current injury or injury within the last year.[4,7] Thus, for a recently injured runner, transitioning to Newton shoes only multiplies risk factors.

New trends in athletic footwear frequently dominate the marketplace and are often directed at the novice runner or someone that suffers from current or previous running injuries. However, in contrast, Newton's recent Web site disclaimer clarifies that Newton shoes are only for the small percentage of runners who have not been injured and are not at risk for injury. As physical therapists, we should be aware of the growing trend in minimalist shoes. It has been proposed that runners who have "intact neuromuscular systems" can increase the strength of their feet with the use of minimalist shoes.[8] Those runners trying the shoe should have at least 3 consistent years of running experience and no injuries within the past year because runners who do not meet these criteria are more at risk for sustaining a new injury.[7] In addition, the runner must gradually introduce the minimalist shoe into their training program so that their body is able to adapt to the decreased support these shoes offer. Minimalist shoes may be appropriate for some runners or in specific instances but scientific studies in this regard are lacking. We believe the data to date shows that minimalist shoes should NOT be marketed as a blanket solution for the general runner nor be chosen based only on foot type. Certainly in JR's case, the minimalist shoe appears to have amplified his predisposition to injury.

This case was seen at Orthopedic Rehabilitation Specialists, an outpatient physi-

Figure 1. Shoe inspection revealed mechanical breakdown of the minimalist shoe's medial platform (right). The minimalist shoe (right) demonstrates a break in the midfoot, while the stability shoe (left) breaks at the metatarsal heads.

Figure 2. Comparison of the left orthotic used in the stability shoe (left) versus the minimalist shoe (right), clearly demonstrates a more dramatic breakdown of the minimalist orthotic at the medial arch.

cal therapy clinic in Miami, FL. At the time of the case, the patient, JR, was under the care of Sokunthea Nau, DPT. We understand that running injuries are multifactoral based on both intrinsic and extrinsic factors. Although the change in footwear may be related to the injury described in this case, the authors cannot establish a cause-effect relationship between footwear and running injury for this patient. Therefore, the opinions or assertions contained herein are the personal views of the authors and are not to be construed as supported outside the limitations of this case report. However, as musculoskeletal specialists, we must be able to identify possible risk factors for this patient's injury to include: less than 3 years of running experience, a running injury within the last year, and transitioning to minimalist footwear.

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A Survey of the Lumbar Spine Tests and Measures Used by Orthopaedic Physical Therapists in the Catholic Health System

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ABSTRACT

Background and Purpose: Low back pain has a high prevalence rate (80%) among the general population. There are a variety of examination tests and measures used to diagnose low back pain. The purpose of this study was to examine the tests and measures used by outpatient physical therapists practicing in hospital-based outpatient clinics. **Methods:** A survey was distributed through SurveyMonkey to 28 outpatient physical therapists in the Catholic Health System of Buffalo, NY. The survey inquired about the lumbar examination techniques used by the physical therapists. Data were analyzed using IBM SPSS. **Results:** The responses of 24 physical therapists were included in the analysis. Years of experience was found to correlate with the usage of the Cyriax and Janda methods of examination. Additionally, results indicated that the McKenzie method was the predominant examination technique used (75%) and the Oswestry questionnaire was used with a frequency of 100%. The standardized measures that demonstrated high frequency included subjective measures (100%), VAS (100%), lower quarter screen (100%), quantitative AROM (95.8%), postural exam in standing (91.7%), palpation for pain (91.3%), postural exam in sitting (87.5%), qualitative AROM (87.5%), lumbar postural exam (83.3%), and repeated movements (78.3%). Special tests that demonstrated high frequency included SLR (95.7%), neural tension testing (91.3%), and slump tests (87%). **Discussion:** Current research suggests that the following examination tests and measures are reliable: McKenzie method, Oswestry questionnaire, VAS pain scale rating, palpation for pain, postural exam, slump tests, and SLR measurements. **Conclusion:** Outpatient physical therapists in this sample are implementing techniques that have mostly moderate to excellent intertester reliability. Further research is imperative to ensure that physical therapists are employing reliable examination techniques to diagnose and treat low back pain.

Key Words: low back pain, McKenzie method, lumbar examination, outpatient

BACKGROUND

Low back pain (LBP) affects approximately 80% of all Americans.[1] Patients with LBP often seek treatment by physical therapists (PT) for this condition. Physical therapists use a variety of examination tests and measures to aid in the decision-making process for treatment. The high prevalence of LBP resulted in the development of various evaluation and treatment approaches. In order to best serve patients, it is imperative that these examination techniques are reliable. Previous research has been conducted to assess the various examination tests and measures for LBP.

Using these various examination techniques has led to the development of classification systems. Classification of patients into categories assists in determining an appropriate intervention provided to the patient's specific impairments and their responses to various examination components.[2] This may result in better outcomes, patient satisfaction, and lower medical costs.[3] Patient classification produces a trend toward improved objective outcome measures, and patients subsequently return to normal daily function within a short time span.[3] Furthermore, the use of these classification systems guides the intervention process.[4] Classifying patients provides PTs with a standardized protocol that concurrently produces greater intertester reliability,[4] and experienced PTs trained together in using a classification system demonstrate greater intertester reliability compared to recently trained PTs.[2,5] This has enabled practicing PTs to use classification systems to categorize patients according to their clinical presentation. Additionally, Fritz et al[3] concluded that a method of classifying patients generally produces improved outcomes. One such classification system is the McKenzie method. Razmjou et al[2] and Clare et al[6] studied the intertester reliability of trained PTs in categorizing patients with the McKenzie method. The authors concluded that with the appropriate amount of training, PTs demonstrated moderate to good interrater reliability.[3,6]

Another key aspect of the examination process of a patient with LBP is the use of questionnaires to provide objective data as a way to demonstrate changes in patients over time. Fritz et al[7] and Davidson et al[8] indicate that the Oswestry Disability Index (OSW) exhibits excellent interrater reliability compared to the Quebec Back Pain Disability Questionnaire (QUE) and the Roland-Morris Disability Questionnaire (RMDQ), which both demonstrate moderate interrater reliability. Also, according to Grotle et al,[9] the Fear Avoidance Belief Questionnaire (FABQ) demonstrates higher interrater reliability than the QUE and RMDQ; however, the OSW is more reliable than the FABQ.

Numerous standardized measures, including special tests, assist PTs in the assessment of patients with LBP. Research suggests that correlating these with a patient's reported pain demonstrate improved reliability.[10-13]

The purpose of this study was to survey outpatient PTs in the Catholic Health System (CHS) of Buffalo, NY to determine the frequency of use of the various examination techniques. Our research questions focus on: (1) What are the most commonly used examination techniques among outpatient PTs? (2) Is there a correlation between years of experience and the selection of examination techniques?

METHODS

This research was approved by the Daemen College Human Subjects Research Review Committee and the Catholic Health System Institutional Review Board. A 59 item Likert scale survey was prepared and distributed using SurveyMonkey. The survey (Appendix 1) was sent to outpatient PTs

employed by the CHS between September 2011 and October 2011. The content of the survey inquired about various examination techniques used by the PTs in the process of diagnosing patients with LBP. Information in the survey included examination approaches, questionnaires, standardized measures, special tests, and years of experience. Each question in the survey involved a 5-point Likert scale (0=never, 1=seldom, 2=occasionally, 3=frequently, and 4=always). The survey was distributed by E-mail to 28 outpatient PTs in the CHS.

STATISTICAL ANALYSIS

Following receipt of the responses, the data were applied to IBM SPSS for analysis. Due to the small sample size, which would have impeded data analysis, the authors grouped the terms never, seldom, and occasionally as "not frequently utilized" and frequently and always as "frequently utilized." Following this grouping, statistical analysis was performed using frequencies to determine how often the PT checked each variable. This provided the researchers with a comparison between commonly used examination techniques and rarely used examination techniques. A Spearman's correlation analysis was used to determine the relationship between the therapists' years of experience and the examination techniques and outcome measures used.

RESULTS

There were a total of 25 respondents to the survey; however, one was excluded from the study secondary to the data originating from a physical therapist assistant. This resulted in a total of 24 respondents to be included in the analysis. A cut-off of 75% for the frequencies was implemented to simplify and aid in the survey analysis.

Examination approach

The McKenzie method was found to be the most frequently used examination approach, demonstrating a 75% frequency rate among the respondents to the survey. The remainder of the examination approaches showed lower frequency rates (Table 1).

Questionnaires

The OSW questionnaire was used by 100% of the respondents. Table 1 lists the other questionnaires and their respective frequencies.

Standardized Measures

Subjective measures, visual analogue scale (VAS), and lower quarter screen (LQS) demonstrated a frequency of 100%. Quantitative AROM was used by 95.8% of PTs. Structural analysis beyond that of a LQS, included postural examination in standing which was used by 91.7% of the respondents, compared to postural exam in sitting, which demonstrated a lesser frequency of implementation at 87.5%. Palpation for pain was found to have a frequency of 91.3% among the respondents. These tests and measures may also be considered part of a LQS, however the items were separated as a PT may only choose to perform one of them without performing the entire LQS. Qualitative AROM, similar to postural exam in sitting, had a frequency of 87.5%. The lesser used standardized measures were the lumbar postural exam, which demonstrated an 83.3% frequency rate and repeated movements, which was used 78.3% of the time (Table 1). Frequencies were adjusted to accommodate respondents who did not answer the question in the survey.

Special Tests

The three most frequently used special tests that PTs favored were the straight leg raise (SLR), neural tension testing, and slump test. Frequencies were 95.7%, 91.3%, and 87% respectively (Table 1).

Years of Experience

The results of the Spearman correlation revealed significant correlation between years of experience and examination techniques for only preferences in use of the Cyriax approach ($p = 0.029$, $r = 0.456$) and Janda approach ($p = 0.028$, $r = 0.457$). Figures 1 and 2 show the positive relationship between each approach used and the years of experience.

DISCUSSION

In the current study, the investigators analyzed the frequency of examination techniques used by outpatient PTs in the CHS. The McKenzie approach was found to be the most frequently implemented examination approach. Based on the literature,

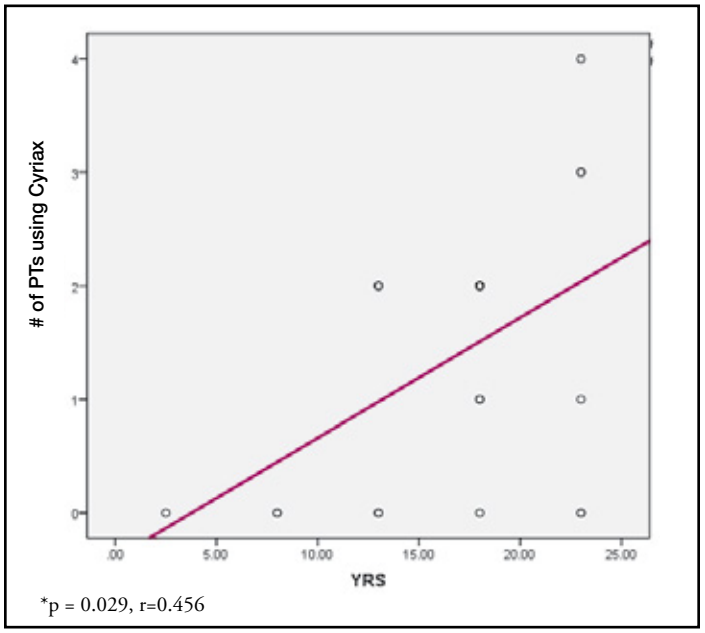

Figure 1. Correlation between years of experience and utilization of Cyriax Approach.*

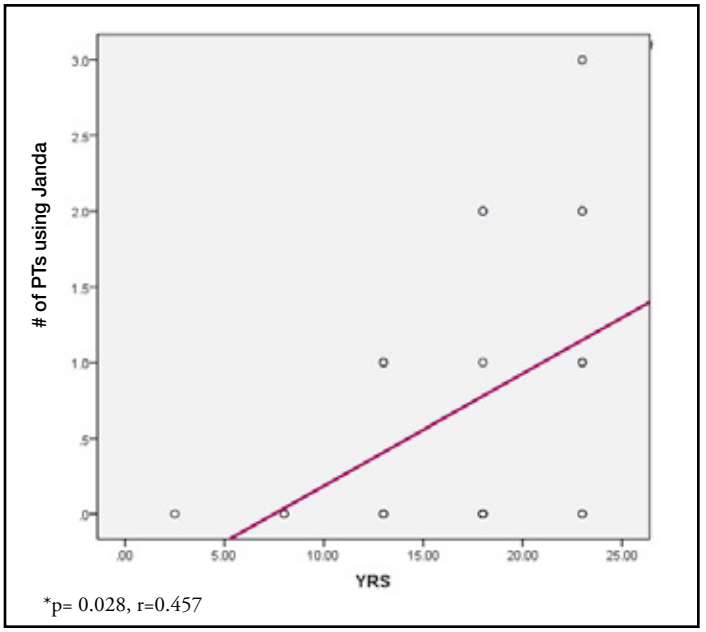

Figure 2. Correlation between years of experience and utilization of Janda Approach.*

Table 1. Frequencies of Exam Tests & Measures

Test & Measure	# of Respondents	Frequency of Seldom	% Used Seldom	Frequency of Frequently	% Frequently
*McKenzie	24	6	25	18	75
Maitland	23	15	65.2	8	34.8
Sahrmann	22	18	81.8	4	18.2
Cyriax	22	18	81.8	4	18.2
Mulligan	22	19	86.4	3	13.6
Janda	22	21	95.5	1	4.5
*Oswestry	24	0	0	24	100
Hendler	21	21	100	0	0
Fear Avoidance Belief Questionnaire	21	19	90.5	2	9.5
Job Satisfaction	21	19	90.5	2	9.5
Roland Morris	20	20	100	0	0
Bournem	21	21	100	0	0
Dallas	21	21	100	0	0
Quebec	21	21	100	0	0
*Subjective	24	0	0	24	100
*Visual Analog Scale	23	1	4.2	23	95.8
*Lower Quarter Screen	24	4	16.4	20	83.3
Structural Exam in Sitting	23	10	43.5	13	56.5
Structural Exam in Standing	22	6	27.3	16	27.7
*Postural Exam in Sitting	24	3	12.5	21	87.5
*Postural Exam in Standing	24	2	8.3	22	91.7
*Postural Exam of Lumbar Spine	24	4	16.7	20	83.3
*AROM Qualitative	24	3	12.5	21	87.5
*AROM Quantitative	24	1	4.2	23	95.8
AROM Goniometer	23	16	69.6	7	30.4
AROM Inclinometer	23	12	52.2	11	47.8
AROM Tape Measure	24	19	79.2	5	20.8
AROM Other	24	20	83.3	4	16.7
PROM Goniometer	24	21	87.5	3	12.5
PROM Inclinometer	22	20	90.9	2	9.1
PROM Tape Measure	24	22	91.7	2	8.3
PROM Other	24	22	91.7	2	8.3
12/18/12	24	18	75	6	25
PIVM Nonweight Bearing	24	9	37.5	15	62.5
Strength Dynamometer	23	22	95.7	1	4.3
Strength Manual Muscle Test	23	10	43.5	13	56.5
Strength Isometric	23	12	52.2	11	47.8
Strength Other	22	21	95.5	1	4.5
*Repeated Movements	23	5	21.7	18	78.3
Palpation for Symmetry	23	6	26.1	17	73.9
*Palpation for Pain	23	2	8.7	21	91.3
Palpation for Restriction	23	12	52.2	11	47.8
SI Provocation Tests	23	7	30.4	16	69.6
SI Movement Tests	23	7	30.4	16	69.6
*Slump Test	23	3	13	20	87
*Straight Leg Raise	23	1	4.3	22	95.7
Prone Knee Bending Test	23	7	30.4	16	69.6
Quadrant Test	23	11	47.8	12	52.2
Schober Test	22	20	90.9	2	9.1
Thomas Test	22	15	68.2	7	31.8
Femoral Nerve Testing	23	11	47.8	12	52.2
Valsalva Maneuver	22	17	77.3	5	22.7
Compression Test	22	10	45.5	12	54.5
Distraction Test	22	8	36.4	14	63.6
Ober Test	23	11	47.8	12	52.2
Rectus Femoris Test	22	10	45.5	12	54.5
*Neural Tension Tests	23	2	8.7	21	91.3
Segmental Instability Testing	23	11	47.8	12	52.2
Functional Tests	22	7	31.8	15	68.2

AROM, active range of motion; PROM, passive range of motion; PIVM, passive intervertebral motion; SI, sacroiliac

the McKenzie approach has demonstrated reliability with kappa values ranging from 0.52-1.0.[2,6] These values indicate moderate to excellent interrater reliability, supporting the high use of this approach within the CHS. Additionally, the Movement System Balance Approach (Sahrmann approach) was also found to be reliable when using symptom behavior. VanDillen et al[5] concluded excellent intertester reliability with kappa values of 0.87-1.0. Therefore, the Movement System Balance Approach may also be a preferred clinical tool when classifying patients with LBP.

The OSW questionnaire exhibited a 100% frequency. This result was expected because use of the OSW, although not required as a measure, is strongly encouraged by the CHS as a measure to be used by physical therapists. Although this can be viewed as a bias to our data, past studies have shown the OSW to be a reliable measure. Fritz et al[7] found an interclass correlation (ICC) value of .90 for the OSW is 0.90and Davidson et al[8] reported an ICC value of greater than 0.8. The preference in using this measurement scale OSW seems to be supported by the previous studies concluding that it is at least a reliable measure. The Quebec Back Pain Disability Questionnaire (QUE) has shown variable reliability with ICC values ranging from 0.55[7] and greater than 0.8.[8] Even though the QUE has been found to be reliable, there was no report of its use amongst the survey respondents. Furthermore, the Fear Avoidance Belief Questionnaire (FABQ) was only used by 9.5% of the PTs; however, according to Grotle et al,[9] this questionnaire has an ICC value of 0.74, indicating good reliability. If one considers the reliability of both these measures, then the QUE and FABQ should be considered for use by physical therapists as well.

The following standardized measures were frequently used based on the survey results: subjective measurements, VAS, LQS, postural exam (sitting, standing, and lumbar), AROM (qualitative and quantitative), repeated movements, and palpation for pain. Although the LQS and AROM (qualitative and quantitative) are considered somewhat subjective measures, they were frequently used despite the fact that no corresponding reliability can be found for these tests. However, these commonly used measures are essential components of initial examinations and provide information that may be useful in determining the initial condition of the patient and also influence the intervention process. The remainder of the above stated standardized measures (VAS, LQS, postural exam) demonstrated good to excellent reliability. The corresponding kappa values are shown in Table 2.

Other standardized measures that displayed good to excellent reliability included AROM measured with a goniometer or tape measure, exhibiting kappa values of 0.70[16] and 0.91[17] respectively. These standardized measures were implemented frequently by 30.4% and 20.8% of the respondents respectively. Strength assessed by isometric testing was only reported to be used by 47.8% of the surveyed PTs; however, the reliability reported by Roussel et al[18] was 0.93-0.97, indicating excellent reliability. The reliability of isometric strength testing may support its use for the examination of patients with LBP.

Three of the special tests that were used most frequently included slump test, SLR, and neural tension test, displaying frequencies of 87.0%, 95.7%, and 91.3% respectively. A literature review by the authors did not reveal reliability of the neural tension test; however, the slump test and the SLR (both types of neural tensions tests) were found to be highly reliable, demonstrating a kappa coefficient of 0.71 and 0.80 respectively.[19] Additionally, Bertilson et al[20] concluded a kappa coefficient of 0.92 for the SLR. The literature supports the frequent use of the slump test and SLR to be diagnostically useful, and therapists may find these special tests useful in the examination process.

Both the Janda and Cyriax examination approaches have been used by PTs for many years. The greatest correlation occurred with respondents practicing for 20 to 25 years. Both Janda and Cyriax approaches are older examination techniques. However, the literature does not support their reliability. These correlations demonstrate a possible link to continuing education and evidence-based practice. The data suggests PTs with less years of experience are using more reliable examination approaches such as the McKenzie method.[6,14] Therefore, more recent PT graduates have been exposed to current evidence on reliable examination and procedures. The advocacy of implementation of best evidence in current educational curriculums and the current initiative toward evidence-based practice may be a factor in newer graduates applying these measures in practice.

Table 2. Comparison Between Frequently Used Examination Techniques and Corresponding Reliability

McKenzie	75	0.52-1.02,6
Oswestry	100	>0.88,7
Subjective	100	N/A
Visual Analog Scale	100	0.92510
Lower Quarter Screen	100	N/A
Postural Exam (sitting, standing, lumbar)	87.5, 91.7, 83.3	0.5618
AROM Qualitative	87.5	N/A
AROM Quantitative	95.8	N/A
Repeated Movements	78.3	0.7914
Palpation for Pain	91.3	0.21-0.7315
Slump Test	87	0.7119
Straight Leg Raise	95.7	0.82-0.9219,20
Neural Tension Test	91.3	N/A

LIMITATIONS

There are a number of limitations to this study. There was a small number of outpatient PTs to survey within the CHS, which limited the available data to be analyzed. This also restricted the power of our data. Furthermore, the use of PTs within the CHS prevents the use of generalization from the data. More research needs to be completed to provide data from a larger range of practicing PTs in more varied environments. Another limitation was the lack of fully completed surveys from all participants. This may imply inadequacy of the survey items to accurately capture the needs of the respondents. Individuals may not have answered a question because they did not understand the question or the item

within the question. If more information was provided, there may have been better fulfillment of the survey and there would not have been a need to adjust the data for the missing responses.

CONCLUSIONS

Physical therapists within the CHS implement examination techniques of the lumbar spine that demonstrate moderate to excellent reliability. More research needs to be conducted with a larger heterogeneous sample size to generalize the results of this study to other health care practices or health care systems.

ACKNOWLEDGEMENT

The authors thank the administrators and physical therapists with Catholic Health in Buffalo, NY for their assistance in this study.

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(Appendix 1 follows on the next two pages.)

Appendix 1. Lumbar Spine/SIJ Survey Questions

What is your title: _____

Are you a Board Certified clinical specialist, and if so in what area?: _____

Other Physical Therapy certifications:_____

How long have you been in practice: 0-5 6-10 11-15 16-20 20+

I. Examination Approach- As a component of my clinical practice, I utilize the following examination systems for evolution of patients with low back pain (LBP):

	Always	Freq.	Occas.	Seldom	Never
McKenzie method	☐	☐	☐	☐	☐
Maitland system	☐	☐	☐	☐	☐
Sahrmann approach	☐	☐	☐	☐	☐
Cyriax approach	☐	☐	☐	☐	☐
Mulligan system	☐	☐	☐	☐	☐
Janda approach	☐	☐	☐	☐	☐

II. Questionnaires- As a components of my clinical practice, I utilize the following questionnaires:

	Always	Freq.	Occas.	Seldom	Never
Oswestry or Modified Oswestry Disability Index	☐	☐	☐	☐	☐
Hendler 10 Minute Screening Test for Chronic Low Back Pain	☐	☐	☐	☐	☐
Fear Avoidance Belief Questionnaire	☐	☐	☐	☐	☐
Job Satisfaction Questionnaire	☐	☐	☐	☐	☐
Roland-Morris Disability Questionnaire	☐	☐	☐	☐	☐
Bournemouth Questionnaire	☐	☐	☐	☐	☐
Dallas Pain Questionnaire	☐	☐	☐	☐	☐
Quebec Back Pain Disability Questionnaire	☐	☐	☐	☐	☐

III. Standardized Measures- As a component of my clinical practice, I utilize the following standard measures:

	Always	Freq.	Occas.	Seldom	Never
History (Subjective Exam)	☐	☐	☐	☐	☐
Pain on a visual/verbal analog scale (VAS)	☐	☐	☐	☐	☐
Lower Quarter Screen (LQS)	☐	☐	☐	☐	☐
Structural Exam/detailed assessment of alignment and symmetry in sitting	☐	☐	☐	☐	☐
Structural Exam/detailed assessment of alignment and symmetry in standing	☐	☐	☐	☐	☐
Postural exam in sitting- general	☐	☐	☐	☐	☐
Postural exam in standing- general	☐	☐	☐	☐	☐
Postural exam for lumbar alignment/symmetry	☐	☐	☐	☐	☐
AROM of lumbar spine for quality of motion	☐	☐	☐	☐	☐
AROM of lumbar spine for quantity of motion	☐	☐	☐	☐	☐
AROM of lumbar spine using standard goniometer	☐	☐	☐	☐	☐
AROM of lumbar spine using inclinometers	☐	☐	☐	☐	☐
AROM of lumbar spine using tape measure	☐	☐	☐	☐	☐
AROM of lumbar spine other methods Indicate:	☐	☐	☐	☐	☐
End feel/PROM of the lumbar spine using standard goniometer	☐	☐	☐	☐	☐
End feel/PROM of lumbar spine using inclinometers	☐	☐	☐	☐	☐
End feel/PROM of lumbar spine using tape measure	☐	☐	☐	☐	☐

	Always	Freq.	Occas.	Seldom	Never
End feel/PROM of lumbar spine using other methods Indicate:	☐	☐	☐	☐	☐
Passive Intervertebral Motion Testing weightbearing	☐	☐	☐	☐	☐
Passive Intervertebral Motion Testing non-weightbearing	☐	☐	☐	☐	☐
Muscle strength of the lumbar spine using a Dynomometer	☐	☐	☐	☐	☐
Muscle strength of the lumbar spine using standardized MMT	☐	☐	☐	☐	☐
Muscle strength of the lumbar spine using resisted isometrics/break test	☐	☐	☐	☐	☐
Muscle strength of the lumbar spine using other methods Indicate:	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
Repeated End Range Movements of the lumbar spine	☐	☐	☐	☐	☐
Palpation of the lumbar spine for symmetry/alignment	☐	☐	☐	☐	☐
Palpation of the lumbar spine for tenderness/irritability	☐	☐	☐	☐	☐
Palpation of the lumbar spine for myofascial restriction	☐	☐	☐	☐	☐
Sacroiliac Joint					
Tests for provocation (Distraction/Gapping, Posterior Shear/Thigh Thrust, Compression, Pelvic Torsion, Cranial Shear, Sacral Thrust)	☐	☐	☐	☐	☐
Tests for movement/symmetry (Gillet, Seated PSIS Height/Piedallu's Sign, Supine to Sit, Measure of Leg Length, Standing Flexion, Seated Flexion)	☐	☐	☐	☐	☐

IV. Special Tests- As a component of my clinical practice, I utilize the following special examination tests:

	Always	Freq.	Occas.	Seldom	Never
Slump Test	☐	☐	☐	☐	☐
Straight Leg Raise Test	☐	☐	☐	☐	☐
Prone Knee Bending (Naclas) Test	☐	☐	☐	☐	☐
Quadrant Test	☐	☐	☐	☐	☐
Schober Test	☐	☐	☐	☐	☐
Thomas/ 3 Muscle Kendall Test	☐	☐	☐	☐	☐
Femoral Nerve Tension Test	☐	☐	☐	☐	☐
Valsalva Test	☐	☐	☐	☐	☐
Compression	☐	☐	☐	☐	☐
Distraction	☐	☐	☐	☐	☐
Ober Test	☐	☐	☐	☐	☐
Rectus Femoris Test	☐	☐	☐	☐	☐
Neural Tension Tests	☐	☐	☐	☐	☐
Segmental Instability Tests	☐	☐	☐	☐	☐
Functional Testing	☐	☐	☐	☐	☐

1st Annual Orthopaedic Section Meeting

We are excited to present our first annual meeting for the master clinician! Plan to attend this hands-on advanced continuing education event and be a part of an exceptional meeting, as well as have opportunities to socialize and network with your colleagues. This 2-day meeting will provide the physical therapist attendee an opportunity to attend general session lectures and hands-on breakout sessions related to physical therapist examination and treatment of the lumbosacral spine and lower extremity. Attendees will have the ability to choose between multiple small-group breakout sessions during both days of this conference.

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1. Meet, discuss, and learn with the experts in lumbosacral and lower quarter musculoskeletal function and rehabilitation.
2. Experience advanced hands-on clinical skill acquisition in small learning lab groups.

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1. recognize and implement strategies and interventions for effective, standardized evidence-based treatment of the lumbar spine and lower extremity conditions using the treatment based classification system and the ICF model;
2. understand, recognize and implement a more standardized, quality-improvement based approach for the treatment of low back pain;
3. incorporate interviewing, counseling and patient education strategies to address the cognitive behavioral disorders commonly seen with LBP;
4. identify and incorporate appropriate thrust manipulation techniques and use of motor control training exercises for patients with LBP;
5. understand and perform treatment for the lumbar spine using the movement systems impairment approach;
6. recognize, assess and understand the psychosocial factors, compensation strategies and published guidelines that can influence rehab outcomes in LE conditions;
7. perform and interpret special tests, exam findings and guidelines for the hip and OA of the LE in order to implement an optimal treatment plan to include manual therapy and motor performance; and
8. clinically differentiate plantar and posterior heel pain and perform evidence-based interventions.

Additional Questions?

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Program Information

THURSDAY, MAY 2, 2013

Opening Reception & Keynote Presentation: 6:00 PM – 9:00 PM
The Paradox of Autonomy: Demonstrating Value in a Post Health Care Reform World
Presenter: Justin Moore, PT, DPT, Vice President, APTA Public Policy, Practice, and Professional Affairs Dept.

FRIDAY, MAY 3, 2013

Daily Schedule: 8:00 AM – 5:00 PM
General Session 8:00 AM – 10:00 AM:
Implementing Evidence-based Standards in Low Back Pain Care
Presenters: Anthony Delitto, PT, PhD, FAPTA; Julie Fritz, PT, PhD, ATC; James Irrgang, PT, PhD, ATC, FAPTA

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

Session 1: ***Education and Counseling Strategies for Patients with Low Back Pain and Related Anxiety, Depression, or Generalized Pain***
Presenter: Joseph Godges, DPT, PT, MS, OCS

Session 2: ***Thrust Manipulation Skills for the Lumbar and Lumbosacral Spine***
Presenter: William O'Grady, PT, DPT, OCS, FAAOMPT
***** This breakout session is for physical therapists with evidence in prior instruction in HVLA techniques.**

Session 3: ***Lumbopelvic Motor Control: Moving Evidence into Action***
Presenter: Deydre S. Teyhen, PT, PhD, OCS

Session 4: ***Assessment and Treatment of Movement System Impairments in People with Low Back Pain***
Presenter: Linda Van Dillen, PT, PhD

SATURDAY, MAY 4, 2013

Daily Schedule: 8:00 AM – 5:00 PM
General Session: 8:00 AM – 10:00 AM
Factors Influencing Rehabilitation Outcomes in Lower Extremity Conditions
Presenters: Terese Chmielewski, PT, PhD, SCS; Marcie Harris Hayes, PT, DPT, MSCI, OCS; Bryan Heiderscheit, PT, PhD

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

Session 5: ***Hip Techniques***
Presenter: Keelan Enseki, PT, SCS, OCS

Session 6: ***Evaluation and Treatment Considerations for Lower Extremity Osteoarthritis***
Presenter: G. Kelley Fitzgerald, PT, PhD, FAPTA

Session 7: ***Plantar and Posterior Foot Pain: Focus on Plantar Fasciitis and Achilles Tendinopathy***
Presenter: Deb Nawoczenski, PT

Session 8: ***Evidence-based Evaluation and Treatment of Anterior Cruciate Ligament Injury in Active Individuals***
Presenter: Lynn Snyder-Mackler, PT, ScD, SCS, FAPTA

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Reliability and Validity of an iPhone® Inclinometer as Compared to a Universal Goniometer as a Tool for Measuring Joint Motion of the Shoulder in Apparently Healthy Subjects

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ABSTRACT

Background and Purpose: The objective of this study was to evaluate the interrater and intrarater reliability of the iPhone's TiltMeter application and the concurrent validity between the iPhone inclinometer and a universal goniometer in measuring shoulder joint motion. No study is currently published examining the reliability and validity of the iPhone inclinometer for use in physical therapy practice. **Methods:** Participants were positioned supine in two positions of shoulder flexion, 0°-90° and 91°-180°. Each position was measured twice by two examiners with the inclinometer and goniometer. **Findings:** Intrarater reliability ICCs for the iPhone ranged from 0.92 to 0.99 and for the goniometer from 0.86 to 0.98. The interrater reliability ICCs for the iPhone ranged from 0.84 to 0.91 and for the goniometer from 0.63 to 0.88. Concurrent validity for the two devices yielded ICC values ranging from 0.67 to 0.94. **Clinical Relevance:** Both devices are acceptable for clinical use. However, this was only true when the rater and device were the same for all measurements. The devices should not be used interchangeably.

Key Words: assessment, range of motion, smart phone

INTRODUCTION

According to the *Guide to Physical Therapist Practice*,[1] the examination of joint integrity and mobility is necessary to select appropriate interventions. Goniometry is widely used in physical therapy practice for this purpose.[2] Over the last 10 years, bubble and digital inclinometers have been introduced into practice.[3] Each of these methods has been shown to be reliable but not interchangeable.[3,4] Clinical practice is often advanced with the integration of new technology. Handheld electronic devices are very common in modern culture, the iPhone and its numerous software applications or apps makes it an attractive tool for clinical practice. Specifically, applications have been developed to take advantage of the iPhone's accelerometer and gyroscope to measure angles. The TiltMeter is one of these applications.

Some benefits of a digital inclinometer include readability, portability, and ease of access as many therapists keep their mobile devices on their person.[3] Reproducibility of measurements and proven validity of the iPhone inclinometer may greatly affect the way physical therapists perform measurements in the clinical setting and research. The purpose of this study was to evaluate the interrater and intrarater reliability of the iPhone TiltMeter application as well as the concurrent validity between the iPhone inclinometer and a universal goniometer in measuring shoulder joint motion. Previous studies indicate that digital inclinometers are reliable and valid for measuring joint motion when using strict measurement protocols.[3,4]

METHODS

Participants

Twenty participants were selected from the Doctor of Physical Therapy (DPT) students at Mount St. Mary's College. Participants were recruited with flyers and E-mail notifications. Exclusion criteria were an inability to move through 170° of shoulder flexion or pain with a sustained passive shoulder position above or below 90°. No participants were excluded from this study. Participants were instructed to wear clothes that exposed the landmarks needed for shoulder ROM testing. Participants provided informed consent and the rights of the subjects were protected.

Universal Goniometer

The goniometer used in this study was a 12-inch, 360° goniometer, marked in one degree increments, with one adjustable arm that overlaps a fixed arm. The adjustable arm rotates about the axis on the fixed arm and measurements are taken by reading the degree value of the angle between the adjustable and fixed arms.

iPhone TiltMeter Inclinometer

We used the TiltMeter application, by IntegraSoft–Carlos E. Hernandez Perez, version 1.1.1, released: October 09, 2010, and available on the Apple Applications Store. The TiltMeter inclinometer is an iPhone application that measures the angles and elevation from each of the 4 edges of the iPhone (Figure 1). It was chosen due to its high user ratings, popularity among other inclinometer applications, and positive comments about its functionality.

Figure 1. Screen shot of TiltMeter on iPhone.

Examiner Training

Two examiners were educated on the devices and practiced using the TiltMeter inclinometer and goniometer prior to the data collection trials (KV and DA). Education and practice consisted of a 15 minute lecture on how to use each device. The lecture was given by one of the investigators (EE), a third year DPT student. Instructions were based on the digital inclinometer protocol used by Kolber et al.[3] The placement of the inclinometer was to be as close to the center of the humerus as possible. Goniometric placement was based on Norkin and White,[5] and the landmarks were the thorax and the lateral condyle of the humerus with an axis of rotation at the greater tubercle of the humerus. The lecture was followed with a lab session where each tester performed 5 measurements above 90° and 5 below 90° with each device on one subject. These measurements were observed and critiqued by the instructor, EE. A tester was deemed proficient in using a device once their intrarater reliability reached 0.85 or higher. Both examiners were deemed reliable with intrarater measurements using the goniometer (KV: r = 0.87; DA: r = 0.92) and the digital inclinometer (KV: r = 0.97; DA: r = 0.95).

Procedure

Participants were scheduled for one of two sessions in groups of 10. The subjects entered one at a time, were positioned supine on a plinth and were placed into different ranges of shoulder flexion from 0° to 90° using different sized wedges (Figure 2). Once all participants were positioned, examiners began range of motion (ROM) measurements. There were two examiners (KV and DA) and one recorder (EE). One examiner began with the inclinometer and placed it twice on the first participant with the recorder taking two measurements per participant. The inclinometer measurement was always performed first. The second examiner began with the goniometer lining it up twice on the first participant with the same recorder taking two measurements per participant as well. Once the first participant was measured in this fashion, the examiners switched devices and repeated measurements. The examiners and recorder then measured the next participant. Once all 10 participants were measured, the participants were repositioned into a range above 90° of shoulder flexion using the wedges. The testing procedure was repeated measuring the participants in the same order.

The recorder documented measurements without verbal or visual cues given to the examiner to eliminate examiner bias within the study (Figure 2). Each examiner measured each participant 4 times for each test position, two times with the goniometer and two times with the inclinometer.

Data Analysis

The strategy for data analysis followed that of Mullaney et al,[5] assessing reliability within the study was based on the intraclass correlation coefficient (ICC). Intrarater reliability, interrater reliability, and the concurrent validity were assessed using ICCs.[7] Mullaney et al[5] compared

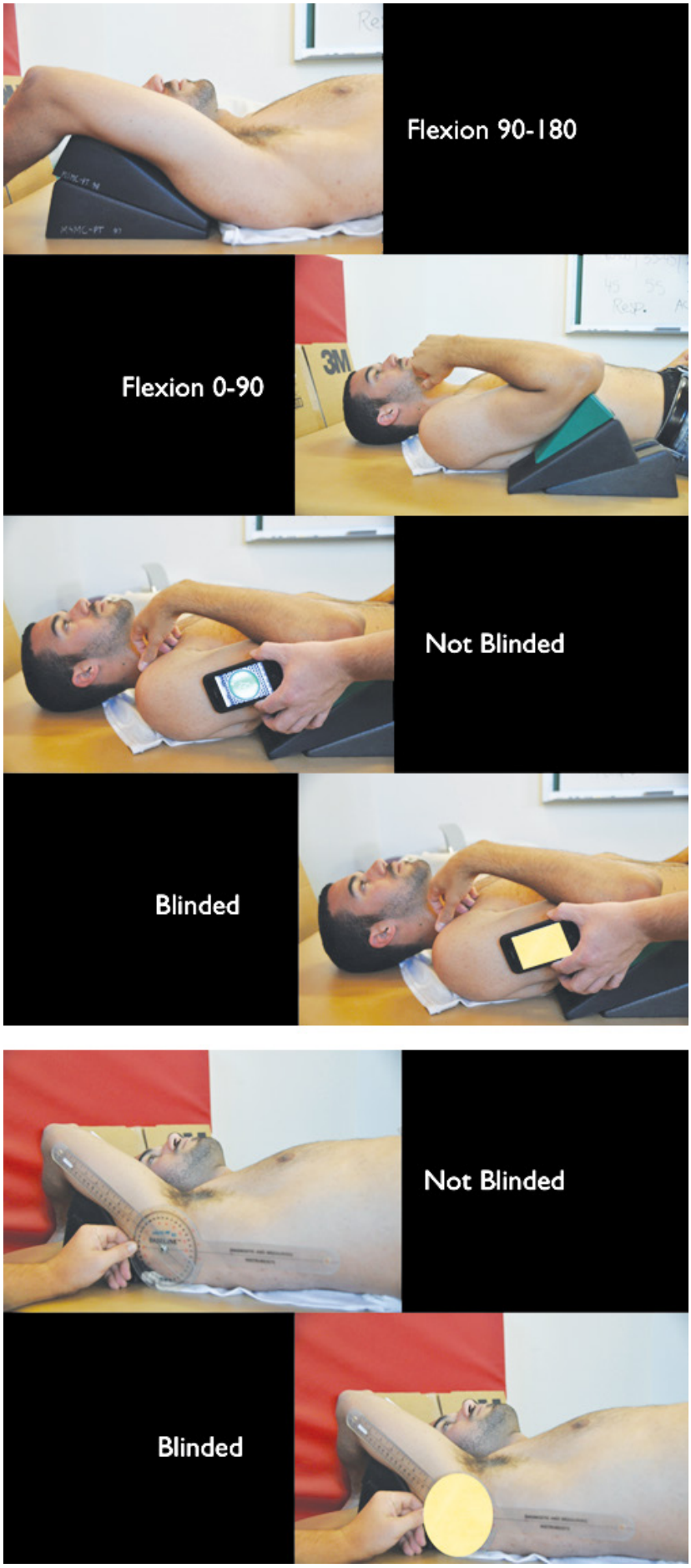

Figure 2. Experimental set-up.

the reliability of a digital level to a standard goniometer in this fashion and found this approach to be reliable. The Statistical Package for the Social Sciences version 17.0 was used for data analysis.

RESULTS

Participants

This study assessed shoulder ROM for 20 participants, 6 male (mean age = 28.3 years, SD= 3.1) and 14 females (mean age = 26.7 years, SD = 2.1).

Inclinometer

Table 1 displays inclinometer data by shoulder position, (above or below 90°), testing group, and tester. The final row displays the interrater reliability between the two testers for that specific group and range. Intrarater reliability was high for both examiners using the inclinometer (r = 0.92 to 0.99). While slightly lower, interrater reliability showed moderate to high reliability between the two examiners (r = 0.82 to 0.95).

Goniometer

Results for goniometric data by participant group and examiner appear in Table 2. Intrarater reliability of the two examiners was moderate to high (r = 0.86 to 0.98). Interrater reliability of measurements above 90° were high (r = 0.82 to 0.94); below 90° they were poor to moderate (r = 0.63 to 0.75).

In Table 3, participant groups were combined for the inclinometer at each position. For the combined data, inclinometer intrarater reliability (r = 0.97 to 0.98) and interrater reliability (r = 0.84 – 0.91) remained moderate to high. In Table 4, participant groups were combined for the goniometer measurement at each position. For the combined data, goniometric measurements below 90° had high intrarater reliability (r = 0.91 to 0.95), yet only moderate interrater reliability (r = 0.63). Goniometric measurements above 90° had high intrarater reliability (r = 0.97 to 0.98) and good interrater reliability (r = 0.88).

Concurrent Validity

Concurrent validity between the iPhone inclinometer and goniometer is displayed in Table 5. Group 1 measurements below 90° displayed good concurrent validity (r = 0.81 to 0.89) for both examiners. Group 2 measurements with the same ROM criteria, however, were only moderate for both examiners (r = 0.65 to 0.74). On the contrary, concurrent validity for both group measurements above 90° were good to high (r = 0.87 to 0.97), with slightly lower ICCs in Group 1 (r = 0.87 to 0.91) versus Group 2 (r = 0.96 to 0.97).

With measurements from the two groups combined with regard to ROM, concurrent validity was relatively poor for measurements below 90°, and high for measurements above 90°.

DISCUSSION

The aim of this study was to compare the intrarater reliability, interrater reliability, and concurrent validity between the universal goniometer and the iPhone inclinometer. Results from this study reveal 3 primary findings. When comparing Tables 3 and 4, it appears that the iPhone inclinometer has slightly higher intrarater reliability. However, when groups were combined, both the iPhone inclinometer and the universal goniometer were shown to have high to very high intrarater reliability with ICCs ranging from 0.97 to 0.98 and from 0.91 to 0.98, respec-

Table 1. Intrarater and Interrater Reliability for the iPhone Inclinometer (ICCs) by Participant Group and Examiner

	Inclinometer ROM 0°-90°		Inclinometer ROM 91°-180°	
Examiner	Group 1	Group 2	Group 1	Group 2
*Intrarater A	0.96	0.99	0.95	0.92
*Intrarater B	0.98	0.97	0.97	0.97
†Interrater	0.87	0.82	0.83	0.95

*A and B refer to the respective examiners.
†Interrater reliability values between examiners A and B

Table 2. Intrarater and Interrater Reliability (ICCs) for Goniometer by Participant Group and Examiner

	Goniometer ROM 0°-90°		Goniometer ROM 91°-180°	
Examiner	Group 1	Group 2	Group 1	Group 2
*Intrarater A	0.91	0.98	0.97	0.98
*Intrarater B	0.97	0.86	0.95	0.98
†Interrater	0.75	0.63	0.82	0.94

*A and B refer to the respective examiners
†Interrater reliability values between examiners A and B

Table 3. iPhone Inclinometer Intrarater and Interrater Reliability (ICCs) for all Participants Combined

	Inclinometer Groups Combined	
Examiner	0°-90°	91°-180°
*Intrarater A	0.98	0.98
*Intrarater B	0.97	0.97
†Interrater	0.84	0.91

*A and B refer to the respective examiners
†Inclinometric interrater reliability values between examiner A and B

Table 4. Goniometer Intrarater and Interrater Reliability (ICCs) for all Participants Combined

	Goniometer Groups Combined	
Examiner	0°-90°	91°-180°
*Intrarater A	0.95	0.98
*Intrarater B	0.91	0.97
†Interrater	0.63	0.88

*A and B refer to the respective examiners
†Goniometric interrater reliability values between examiner A and B

Table 5. Concurrent Validity (ICCs) between the iPhone Inclinometer and Goniometer per Participant Group

	Measurements 0°-90°		Measurements 91°-180°	
Examiner	Group 1	Group 2	Group 1	Group 2
* concurrent validity A	0.89	0.65	0.87	0.96
* concurrent validity B	0.81	0.74	0.91	0.97

*A and B refer to the respective examiners †Interrater reliability values between examiners A and B

tively. Portney and Watkins[7] suggest that a device is only clinically useful if it produces ICC values that surpass 0.90.[7] Based on this criteria and our results either device may be appropriate for measuring change in shoulder ROM in a population with similar characteristics to our subjects and provided the tester and the device do not change during the course of measurements. The difference in intrarater reliability between the two devices may be due to one or more of the following factors: (1) The readout on the iPhone is digital whereas the goniometer requires the recorder to read and count dashes between numbers. Thus, the error by the examiner in interpreting the value displayed on the iPhone is essentially removed. The potential error from the examiner having to read the goniometer may have influenced our data and falsely resulted in lower intrarater ICCs for the goniometer. (2) Once the iPhone is positioned, the TiltMeter application saves the measurement and the iPhone can be removed from the subject. Digital storage of the measurement is an advantage over goniometers. When the goniometer is removed, there is risk of disrupting the actual measurement. This difference in devices may also be a reason higher intrarater reliabilities were calculated for the iPhone inclinometer. (3) Performing shoulder range of motion measurements with the goniometer was more complex and required the user to align the goniometer axis, distal arm, and the proximal arm. The iPhone is one piece and it was placed in the center of the limb and adjusted to line up with the glenohumeral and elbow joints. The user needs only one hand to place and manipulate the device. These factors may be reasons why the intrarater reliability measures were slightly higher when using the iPhone. Each of the above circumstances can be classified as user error. For clinical practice, a device with less user error is preferred.

The next major finding of this research is the comparison of interrater reliabilities in Tables 3 and 4. Data analysis indicates that measurements with the iPhone had higher interrater reliability (r = 0.84 to 0.91) versus measurements with the goniometer (r = 0.63 to 0.88). Explanations for this result may be attributed to user error and the manner in which the measurements were read from each device. User error has the potential to be higher when using a goniometer due to the 3 components of a goniometer that must be aligned appropriately. Placement of both arms of the goniometer along with the alignment of the axis are all potential causes of measurement variability. Errors in locating a landmark or goniometer placement could lead to different angular measurements. Conversely, the iPhone does not require movement of multiple parts as it only needs to be aligned parallel with the arm for an appropriate measurement. This allows the user to place the iPhone anywhere on the limb so long as they are able to align it parallel with the arm of the subject. Furthermore, the digital readout on the iPhone greatly decreases the potential for error when reading the degree of ROM from the device when compared to the goniometer. With the goniometer, there is a greater potential to misread the measurement due to the closely spaced degree marks labeled numerically only every 10°. If the hash marks between each digit label are miscounted, the measurement will be incorrect. To summarize, the goniometer has three components along with a manual readout producing at least 4 possible sources of potential user error. The iPhone has a digital readout decreasing the likelihood of error when reading the measurement and is one solid piece that needs only to be parallel to the arm of the subject that produces seemingly only one potential source of user error. A device with fewer sources of error should produce measurements that are closer in value to each other when comparing measurements from two different raters performed on the same subject at virtually the same time using the same device. In other words, the results from this study indicate that the iPhone would be more appropriate than the goniometer when more than one rater is measuring a particular subject's shoulder ROM. Otherwise, the true change in shoulder ROM from one rater on one day to a different rater on the next day may be the result of user error rather than an actual difference in the subject's shoulder ROM. Another related finding is that while the iPhone had higher interrater reliability, neither device consistently produced interrater ICC values that could be deemed clinically acceptable, within the 0.90 or higher range. Therefore, it is recommended that the same person consistently measure an individual's shoulder flexion ROM, regardless of the device used.

Lastly, it was determined inappropriate to compare measurements from an iPhone with measurements from a goniometer when measuring shoulder flexion ROM. It is important to note that when measuring a participant's shoulder flexion the inclinometer's measurement was always compared to the calibrated zero whereas the goniometer used the patient's trunk as a reference. Clinically acceptable values were discovered for concurrent validity, however, they were inconsistent. Thus using the devices interchangeably is not recommended. Interestingly, when groups were combined as shown in Table 6, concurrent validity was higher in the above 90° ROM range versus the below 90° ROM range. Surprisingly, in the above 90° ROM range, the concurrent validity would be deemed clinically acceptable. One explanation for this could be that the below 90° ROM measurements were always taken first. After 20 measurements with the goniometer and 20 measurements with the inclinometer consecutively, the increased experience of each tester might have lead to improved technique for measuring the subjects in the above 90° ROM range. Another possible explanation for this difference, as stated above is the change in the patient's trunk at a measurement above 90° versus a measurement below 90°. The goniometer would be more likely to adjust for this change while the inclinometer of the iPhone would continue to measure against its calibrated zero. However, due to the much lower ICC values below 90° ROM, the goniometer, and iPhone inclinometer should not be used interchangeably until the reasons for these findings can be determined.

There are some concerns about using the iPhone in the medical setting. Cell phones are used by the therapists on a daily basis and therefore are likely to carry germs that should not be spread from patient to patient. This should be addressed prior to implementing this into the everyday clinical setting in order to protect the patients and the therapist. Secondly, professional behavior must be maintained while using a cellular phone in the clinical setting. Allowing physical therapists to carry and use their phone as a tool for ROM measurement may prove to be too tempting for some to check E-mail, text, and make calls during a treatment session that would be unprofessional and negatively impact quality of care. However, with good clinical policies in place and a responsible staff, the iPhone and TiltMeter inclinometer application could prove to be a useful and

Table 6. Concurrent Validity (ICCs) between the iPhone Inclinometer and Goniometer for Combined Data

	Groups Combined	
Examiner	0°-90°	91°-180°
concurrent validity A	0.68	0.94
concurrent validity B	0.78	0.94

*A and B refer to the respective examiners

efficient tool to measure ROM. Having the iPhone and Tiltmeter application on hand at all times could decrease the potential for "eyeballing" ROM measurements without using an appropriate tool leading to more accurate patient data. There might also be concern regarding the safety of a radiofrequency device in a hospital setting. This was addressed in a recent study by Tri et al at the Mayo Clinic in Rochester, MN.[8] This group found cell phone and wireless devices do not interfere with medical devices normally present in patient care areas.

CONCLUSION

This study examined the intrarater reliability, interrater reliability, and concurrent validity of the goniometer and the TiltMeter iPhone inclinometer. The findings of this study indicate that either the goniometer or the iPhone inclinometer may be used by the same rater over time as a reliable tool to measure change in shoulder flexion range of motion. However, caution should be practiced when comparing measurements from two different raters using the same device due to the decreased interrater reliability noted in this study, especially when using the goniometer. Using the devices interchangeably is not recommended due to the moderate to low inter-method reliability found with both raters when measuring shoulder joint ROM below 90°. More research is needed to determine why reliability was generally lower when measuring shoulder ROM below 90°. Furthermore, the devices should be compared for accuracy to reveal which device produces measurements closest to the true ROM values when measuring shoulder ROM.

ACKNOWLEDGEMENTS

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This research was not funded.

This research was approved by the Institutional Review Board for Human Subjects for Mount St. Mary's College.

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Book Reviews

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

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

Cram Session in Functional Neuroanatomy: A Handbook for Students and Clinicians, Slack Incorporated, 2012, $31.95
ISBN: 9781617110092, 222 pages, Soft Cover

Author: Nolan, Michael F., PhD, PT

Description: This handbook provides a concise overview of functional neuroanatomy. **Purpose:** It is written to provide students or practicing professionals with an understanding of the human nervous system and its relation to function. It provides an excellent summary of neuroanatomy allowing easy review of specific details to improve understanding of clinical findings. **Audience:** The author's audience is health professionals who are interested in a concise review of neuroanatomy as well as students who are studying the topic for the first time. Although I have been out of professional school for almost three decades and primarily treat clients with musculoskeletal dysfunction, I still refer to my neuroanatomy textbooks for clinical assessment. The author is a professor of basic science and director of assessment at Virginia Tech Carilion School of Medicine. **Features:** Sections in the book discuss the structure and organization of the nervous system; the functional organization of the sensory, somatic motor, visceral motor, and cranial nervous system; cortical organization and higher brain functions; and neuronal environment. Chapters in each section address specific topics in nervous system function, presenting the information as key points. Online resources supporting the book include practice exam questions, self-assessment exercises, and laboratory structures. The index makes it easy to access topics quickly. The best features of the book are the clear explanations of neuroanatomy and the appropriate pictures that provide a visual schematic diagram to support the discussions. **Assessment:** Compared to textbooks on this topic, this handbook makes functional neuroanatomy easy to understand, presenting it in a concise and clear manner. The author has filtered the detailed information and provided a simple review and summary. I recommend this book for practicing clinicians and students who are in the process of learning and understanding neuroanatomy. It is easy to understand and it provides an excellent overview.

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University of Southern California

Dutton's Orthopaedic Examination, Evaluation, and Intervention, 3rd Edition, McGraw-Hill Companies, 2012, $125
ISBN: 9780071744041, 1496 pages, Hard Cover

Author: Dutton, Mark, PT

Description: This is a comprehensive book on the examination, evaluation, and treatment of orthopedic physical therapy patients. This update, coming four years after the previous edition, shows improvement in organization, updated information, and better quality images and photos. **Purpose:** The author sets out to "provide the reader with a systematic and logical approach to the examination and intervention of the orthopedic patient." This book is comprehensive in nature and can supplement other books in the physical therapy student's or clinician's library. The book is successful in that it incorporates multiple approaches to both examination and intervention, while aiming for evidence-based information. **Audience:** It is intended for physical therapy students, yet its breadth and depth make it useful to even the most experienced orthopedic clinicians. **Features:** The first of the book's six sections covers basic anatomy and foundational science of injury and tissue. The chapter on the nervous system is especially comprehensive and clinically useful. Section 2 addresses the examination and evaluation tools to be used for the whole patient, and covers system review, history taking, gait, posture, and imaging. Section 3 addresses a wide variety of intervention strategies, ranging from pharmacology and manual therapy to neurodynamics and goal-specific therapeutic exercises. Section 4 addresses the extremities, and each chapter thoroughly covers the region, including anatomy, biomechanics, test and measures, comprehensive exam techniques, key findings for determining diagnosis and prognosis, a summary of causes for dysfunction, comprehensive intervention strategies (including therapeutic exercise), and a review of treatment progressions for joint-specific practice patterns. A similar pattern is followed in section 5 for the spine and TMJ. The final section considers special populations, including pediatric, geriatric, and pregnant/postpartum patients. The DVD that comes with the book is not comprehensive with regard to manual therapy techniques or therapeutic exercises and, thus, not very practical. The physical size of the book is daunting. A 2-volume version with online supplemental material may have been more practical. **Assessment:** This can be an important addition to a physical therapy curriculum, and will augment other books, including those on musculoskeletal assessment, therapeutic exercise interventions, and special tests. It will be useful for physical therapy students and experienced clinicians. The third edition is an improvement on the previous two, providing more evidence-based practice information, clinical pearls, and a more user-friendly organization.

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Statistics in Kinesiology, 4th Edition, Human Kinetics, Inc., 2012, $44
ISBN: 9781450402545, 378 pages, Hard Cover

Editors: Vincent, William J., EdD; Weir, Joseph P., PhD

Description: This is an update of an introductory book on statistics primarily for students in an exercise science curriculum. The previous edition was published in 2005. **Purpose:** The authors emphasize the practical use of statistics as a tool to help those in the movement sciences analyze data. They meet their objectives, creating an easy to read, relevant book on statistics for the intended audience. **Audience:** Written for students in movement science, the book targets physical educators, coaches, biomechanists, sports

psychologists, exercise physiologists, athletic trainers, and physical therapists. Many of the statistical examples are specific to topics common to physical education and exercise science. The authors have been teaching statistics for several years. **Features:** The first few chapters cover topics such as measurement and organization of data, measures of central tendency and variability, and discuss interpretation of Z scores and standard scores in relation to the normal curve. Subsequent chapters on the basics of statistical inference and hypothesis testing are well written and easy to understand. Parametric and nonparametric statistics are covered in well-organized detail. Topic additions to the fourth edition include effect sizes and confidence intervals as well clinical measures of association (relative risk and odds ratios). The writing is clear and chapters are well organized. Summaries, problems, and a listing of key words end each chapter. Solutions to the problems appear in an appendix. The high-quality figures aid understanding. The book covers statistical theories in enough detail so readers can appreciate their relevance, but this does not overshadow its emphasis on application. **Assessment:** This is an excellent book for those who desire to know more about the practical aspects of statistics in exercise science and allied health professions. The information is introductory and very practical, which makes the book easy to read and enhances comprehension. The fourth edition adds new topics and a new author (Dr. Weir). I highly recommend this book for those in the health professions who seek to understand statistics, but do not want to be overwhelmed by theories and mathematical jargon.

Christopher James Hughes, PT, PhD, OCS, CSCS
Slippery Rock University

Finance Committee Report

Steven R. Clark, Chairman

The Finance Committee met August 2012 to review financial operations and to make recommendations for the 2013 budget. The Gillette & Associates audit of the 2011 Section income/expenses has ascertained that Section operations and its cash flow is in conformity with accepted accounting principles through December 31, 2011.

AUDIT REPORT 2011.
STATEMENT OF ACTIVITY
Years Ended December 31, 2011 and 2010

	2011	2010
UNRESTRICTED NET ASSETS		
Unrestricted Revenues, Gains, Losses		
Membership dues	736,879	716,330
Registration, meetings	729,878	653,126
Advertising income	44,328	40,407
Shipping and handling income	27,927	27,046
Publishing and administrative	38,770	34,766
Sale of promotional items	2,492	2,266
Miscellaneous	9,790	10,829
Investment income	64,604	67,240
Rental income	49,635	44,766
Sale of assets	15,400	239,850
Total Revenue	1,719,703	1,836,626
Less: Administrative Expenses	(268,273)	(263,929)
Program Expenses	(1,082,475)	(1,081,882)
Add: Unrealized Gain (loss) on Investments	(193,728)	177,676
Change in Unrestricted Net Assets	175,227	668,491
Net Assets at Beginning of Year	3,683,579	3,015,088
Net Assets at End of Year	$3,858,806	$3,683,759

MARKETABLE SECURITIES

	2010	2011	9/30/2012
LPL Investment Reserve	$980,830	$919,377	$977,080
LPL Building Fund	$363,561	$347,034	$370,558
Wells Fargo Research, Practice, Education	$1,142,676	$1,538,562	$1,827,138
Certificates of Deposit (3 month ladder)			$355,000

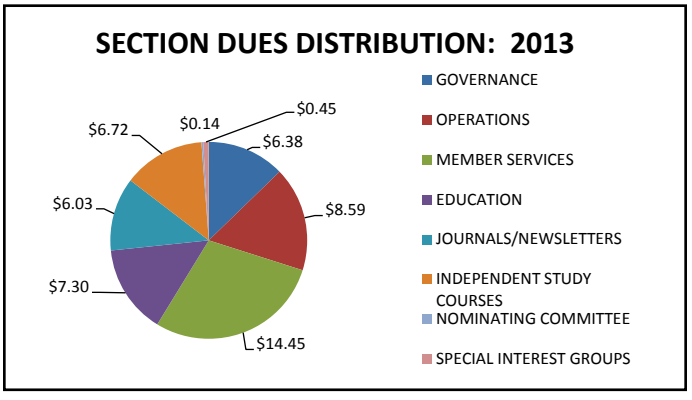
The 2011 audit demonstrates an increase in net assets from 2010 of $175,047. As always, the Section staff must be congratulated on their ability to maximize operations. The net asset increase correlates with an increase in marketable securities and generating income greater than expenses for 2011. Marketable securities remain strong as of 9/2012 giving the Section excellent financial status.

The following operating budget for fiscal year 2013 has been approved by the Section Board of Directors at their October meeting in Albuquerque.

2013 OPERATING BUDGET

	Income	Expense
GOVERNANCE	182,638	245,141
OPERATIONS	50,359	330,268
MEMBER SERVICES	762,140	555,408
EDUCATION	407,615	280,760
JOURNALS/NEWSLETTERS	148,960	231,967
INDEPENDENT STUDY COURSES	370,500	258,163
NOMINATING COMMITTEE	0	5505
OCCUPATIONAL HEALTH SIG		2,500
FOOT AND ANKLE SIG		2,500
PAIN MANAGEMENT SIG		2,500
PERFORMING ARTS SIG		2,500
ANIMAL REHABILITATION SIG		2,500
IMAGING SIG		2,500
TOTAL OPERATING	$1,922,212	$1,922,212

The 2013 budget will continue the Section's effort to progress the evidence-based practice of physical therapy including $50,000 for the Foundation for Physical Therapy and a $100,000 commitment to the Clinical Research Network which is part of the strategic plan total of $300,000 over 3 years. Additionally the Section will have their 1st Annual Meeting providing an opportunity for advanced clinical practice. Increasing membership numbers and member willingness to continue participation in independent study courses allows the Section dues to continue at the current level of $50.00 for physical therapists which reflects no increase since 1994. At this time, the real estate market in LaCrosse does not support the Section moving forward with further rental property, thus a building of the footprint was not recommended. The Board of Director policy is to keep the Building Fund should an opportunity to build the footprint present itself in the future.



If you have questions regarding the audit report for 2010 or the 2012 operating budget, feel free to contact me at Steven@coreptiowa.com.

OCCUPATIONAL HEALTH

SPECIAL INTEREST GROUP

Greetings OHSIG Members!

HAPPY NEW YEAR! THIS IS THE FIRST ISSUE OF 2013. WE HOPE YOU HAD A WONDERFUL HOLIDAY AND ARE LOOKING FORWARD TO A GREAT YEAR AHEAD!

THANK YOU!

This is my last message as President of OHSIG. It has been an honor to serve you. I will continue my involvement as a member of OHSIG, supporting the OHSIG BOD initiatives. I look forward to continuing our work together, supporting those of us working in the area of occupational health. Stay tuned for an announcement of our new officers at CSM!

OHSIG PROGRAMMING CSM 2013

We are looking forward to Combined Sections in San Diego! It's not too late to register—but note the January date. CSM is January 21-23, 2013.

OHSIG programming takes place Tuesday, January 22, 2013. The OHSIG Membership Business Meeting will immediately follow the programming, 12:00 noon – 1:00.

"Unsticking the Stuck Worker – Efficiently Getting Back to Work"
Part I: 8:00 a.m. – 10:00 a.m.
Speaker: Jason Parker, B. HK

Work-related injury or illness comes with a unique set of conditions that may prolong recovery and frustrate the worker, employer, and the physical therapist. This session will provide a set of evidence-based skills and strategies specific to assessing return-to-work motivation and determining risks and predictive factors for prolonged absence from work. These interventions will engage the injured worker, lowering resistance in returning to work. More important, this session will enlighten providers as to behavioral principles from social psychology and motivational science. Attendees will be introduced to a workable model that can be easily used and implemented.

Upon completion of this course, you'll be able to:

1. Identify the significant predictive barriers to returning to work.
2. Recognize the factors that can predict workers having 3 times the odds of chronic disability.
3. Identify the 3 types of resistance to returning to work.
4. Use resistance-reducing strategies to help your client or patient become "unstuck."
5. Discuss work-related goals with your patient.
6. Engage the worker in problem solving.

***Break: 10:00 a.m. – 11:00 a.m.*

"Working Matters: Patients/Clients at Work"
Part II: 11:00 a.m. -1:00 p.m.
Speakers: Jill Dulich; Karen Jost, PT, MS; Kevin Svoboda, PT; Rick Wickstrom, PT, DPT, CPE, CDMS

On average, over 57% of Americans over 16 years of age are employed in some manner. Physical therapists play a vital role in ensuring that they remain at work. From injury prevention and consultation, to postinjury treatment and rehabilitation, physical therapists interact with workers to keep them working. This session will explore the variety of settings, services, and payment sources that you should be aware of as you support the working population. Learn from a panel of experts representing employers, insurers, and physical therapists about what matters when it comes to work.

Upon completion of this course, you'll be able to:

1. Discuss the variety of opportunities available to physical therapists in relation to supporting the workforce.
2. Explain what is important to employers and insurers who are paying for your services.
3. Understand how physical therapists can influence the issues driving reform in the workers' compensation insurance system.
4. Modify your approach to working patients/clients.

12:00 Noon – 1:00 p.m.
OHSIG Membership Meeting
Meet your Board and find out what's new with OHSIG!

We hope to see you!

OHSIG ACTIVITIES since August 2012

- Dee Daley, Rick Wickstrom, and Jill Galper from the OHSIG attended the Second Scientific Conference on Work Disability Prevention and Integration: Healthy Aging in a Working Society. They also attended the 1st International FCE Research Meeting in the Netherlands, Oct 22-25, 2012. See below for a summary from Dee. Thanks to Dee for the excellent summary.
- OHSIG responded to a request for participation regarding the Palace of Service for CMS. This was officially adopted and available to APTA members as of November 2012.
- Continue our work toward specialization/certification in Occupational Health PT. Considering a rewrite after speaking with ABPTS in November.
- Committee to produce 6 monographs for the Independent Study Courses. Authors are in place—we thank the many who responded to our E-mail blast related to the need for authors. Topics include the following:
  a. Work Injury Prevention and Management – Determining Essential Job Demands (What, Why, How) Job Analysis, Functional Job Description and Gap Analysis
  b. Work Injury Prevention and Management – Legal and

Regulatory Consideration – In Both Outpatient and Job Site Settings, Considerations for State and Federal Regulation

c. Work Injury Prevention and Management – The Physical Therapist Role in Injury Reduction/Prevention and Work Force Wellness. Employer needs survey, post offer screen and worker selection, personal protective equipment, wellness initiatives, education of the work force, ergonomics and safety program development and team participation

d. Work Injury Prevention and Management – Injury Management Considering Employment Goals. Onsite triage and clinical applications, job coaching, graduated RTW program outcome measures related to clinical care, functional testing (FCE and fit for duty exams)

e. Work Injury Prevention and Management – Ergonomics – Individual Case and Group Level Evaluation and Interventions and Working with Onsite Resources

f. Work Injury Prevention and Management – Coordination and Communication –Coordinating Medical, Insure, and Employer Stakeholders. Case management and guidelines" such as therapy, AMA, CDG, etc, program outcome measurement, development of ergonomics and prevention programs, nonclinical competencies such as cost benefit analysis, ROI, etc.

- Responded to press release related to Safe Patient Handling (watch for the complete response in the next OPTP President's Message)

Overview of the Second Scientific Conference on Work Disability Prevention and Integration provided by Dee Daley

The Second Scientific Conference on Work Disability Prevention and Integration (WDPI) was held in Groningen, the Netherlands October 22-24, 2012. Several hundred participants and presenters joined together for multidisciplinary scientific presentations, poster presentations, and topical sessions that focused on emerging research related to work disability prevention. Although the conference attendees hailed from around the world, the moderate convention size allowed for face to face interaction with world renowned researchers and interactive sessions/panels.

The theme for day 1 focused on moving from "disability to ability" with key note speakers including Dr. Paul Schnabel speaking on healthy working in an aging society and Dr. Tom Shakespeare on breaking disabling barriers. Their themes of promoting productive capabilities for people of all ages or those with disabilities were explored by break out and topical sessions in the areas of mental health, policy considerations for stay at work/return to work, cancer interventions, disability evaluation, and self management of chronic disorders. Mental disorders and cancer segments reviewed factors influencing long term work absence, predictors of return to work, sociopolitical and economic challenges, and the impact of vocational programs. Perspectives on the outcomes and consequences of policy changes related to return to work management and compensation were also presented, including the relationship between changes in claims management and claim duration, negotiation of responsibility in return to work and work disability trajectories. The disability evaluation segment considered the role of the International Classification on Function (ICF) in disability evaluation, evolving use of structured interview to enhance return to work decisions as well as a literature review revealing challenges to independent medical examination. The segment on facilitation of self management in chronic disorders illustrated Dr. Schnabel's notation that the World Health Organization (WHO) is looking at health not only as the absence of sickness, but the ability to cope and adapt, which reflects many of the findings discussed during day 1.

The day 2 theme "early detection and work disability prevention" started with key note speaker professor, Paul Watson who addressed early identification and management of work related musculoskeletal pain, discussing the facilitation roles of health care professionals, patients and employers in the "return to work" or "retention at work" process. Topical sessions included an expansive look at stakeholder groups as well as qualitative studies on the reasons workers stay at work despite chronic nonspecific musculoskeletal pain and disseminating information through knowledge transfer for best practice use by all stakeholders. Considerations in seasonal/temporary worker populations, the impact of various national standardized benefit time limits (or part time benefits), and the impact of organizational policies and procedures were viewed through the lenses of social, functional, and economic evaluation. The influence of mental health surveillance, exploration of the "worker role," and the role of significant others/family members were also discussed as factors facilitating or preventing return to work, while another session looked at work disability and health inequity assessment challenges facing the BRICS countries (Brazil, Russia, India, China, and South Africa).

"Towards sustainable working life" was the theme of day 3. Keynote speaker Dr. Glenn Pransky spoke on the evolution of work disability prevention and the movement to a recognition of the importance of psychosocial/environmental dimensions beyond a biological/medical model. Dame Carol Black's keynote included perspectives on the inter-related societal, workplace, and personal benefits of wellness and working, as well as policy and political influences in the UK. Sessions on day 3 explored the effectiveness of strategies such as insurance initiated return to work coordination, screening as an alternative to case management, empowering post op patients for return to work, work support and employment for cancer survivors, economic evaluation of participatory RTW, and qualitative studies in diverse worker groups. Topical sessions also included methodological issues in prognostic research, worker screening and assessment in areas of health questionnaires, mental health surveillance, and decision support tools.

Conference topics and presenters included diverse perspectives and backgrounds in medicine, psychology, vocational rehabilitation, public health, public administration, safety, compensation, and statistics; stakeholder participation at this level illustrated Glenn Pransky's keynote point that the concept of "work" is evolving from a medical concept of "work readiness" or "work limitations" to a multidimensional continuum model including concepts such as work readiness, work reentry, stable return to work, and career progression. The third WDPI conference will be located in Toronto ON, Canada in September 2014.

E-MAIL BLASTS

As a reminder, be sure to watch for E-mail blasts from OHSIG. If you do NOT receive E-mail blasts from us and you are an OHSIG member, please let Tara Fredrickson at the Orthopaedic Section office know (800-444-3982 x203) or contact any of the OHSIG BOD. These opportunities are usually time sensitive, so E-mail blasts are the best avenue 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. We thank our 2012 OPTP authors:

1. "Holistic Emphasis" by Chris Juneau, PT, DPT, ATC, EMBA and Student PTs Eric Ingram and Brent Robinson.
2. "The Impact of our Aging Work Force: How Physical Therapy Professionals can Improve their Outcomes" by Nicole Matoushek, MPH, PT, CEAS, CEES
3. "Post Offer Pre-employment Testing" by Douglas P. Flint, DPT, OCS
4. "The Effects of Functional Pre-employment Testing on Work Injuries and Workers' Compensation Costs" by John Levene, DPT, OCS, CMT, MS

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

INTEGRATING SAFETY AND WELLNESS PROGRAMMING

Margot Miller, PT

Let's start with wellness. Wellness is a difficult word to define. Charles B. Corbin of Arizona State University defines wellness as "a multidimensional state of being describing the existence of positive health in an individual as exemplified by quality of life and a sense of well-being." As such, wellness is an active process of becoming aware of and making choices toward a more successful existence.

- Process means that improvement is always possible.
- Aware means that we continue to find ways we can improve.
- Choices mean that we consider a variety of options and select those that are in our best interests.
- Success is determined by each individual and the result of a collection of life accomplishments.

Physical wellness is the ability to maintain a healthy quality of life that allows us to get through our daily activities without undue fatigue or physical stress. The ability to recognize that our behaviors have a significant impact on our wellness and adopting healthful habits (routine checkups, a balanced diet, exercise, etc.) while avoiding destructive habits (tobacco, drugs, alcohol, etc.) will lead to optimal physical wellness. Physical wellness involves aspects of life that are necessary to keep yourself in top condition. Optimal physical wellness is developed through the combination of beneficial physical activity/exercise and healthy eating habits. Elemental components of physical wellness include building muscular strength and endurance, cardiovascular strength and endurance, and flexibility.

Physical wellness is also taking personal responsibility for your own health care, such as caring for minor illnesses and knowing when professional medical attention is needed. Developing physical wellness empowers you to be able to monitor your own vital signs and understand your body's warning signs. The physical benefits of looking good and feeling terrific most often lead to the psychological benefits of enhanced self-esteem, self-control, determination, and a sense of direction.

From a broad perspective, physical wellness can take into account maintaining a desirable weight, engaging in vigorous exercise such as brisk walking, strengthening exercises including warm up and cool down techniques before and after vigorous exercise, getting 7 to 8 hours of sleep each night, eating properly balanced nutritious meals, having enough energy to get through the day without being overly tired, listening to your body and seeking professional help when needed.

Next we look at a model of wellness and safety working in concert with one another. According to an article "Workplace Health Protection and Promotion: A New Pathway for A Healthier – and Safer – Workforce" published in the *Journal of Occupational and Environmental Medicine* (JOEM), employers that integrate their safety initiatives with their health and wellness programming have the potential to improve the overall health and productivity of their workforces. The article was written by a task force from the American College of Occupational and Environmental Medicine (ACOEM) looking at a new organizational model that would unite workplace safety and workplace health and wellness, which are currently separate business units. According to the article, "Traditionally, health

protection and health promotion activities have been viewed as two distinct activities and have operated independently of each other in the workplace. Placing boundaries around these activities (creating workplace 'silos') has been a limiting factor in their overall effectiveness."

A new way of approaching wellness and safety is one that integrates them into a concept called "workplace health protection and promotion." Pam Hymel, MD, lead author and past president of ACOEM states, "This is the path to creating a healthier workforce. While we have made great strides in creating separate cultures of safety and wellness in the United States in recent decades, the two have yet to meet and merge into a truly sustainable culture of health."

Health protection can be defined as activities that protect workers from occupational injury and illness, ranging from basic safety training to the use of protective gear, work organization, and safety enhancing modifications to equipment. Health promotion, by contrast, can be defined as activities that maintain or improve the personal health of a workforce, ranging from health-risk assessments to wellness initiatives and immunizations. Integrating health promotion and health protection activities along a continuum improves personal safety in addition to enhancing personal health, while occupational safety interventions contribute dynamically to improved personal health in addition to enhancing personal safety. "The two factors, personal health and personal safety--each essential to a productive worker and to a productive workplace--are effectively combined in a symbiotic manner way that increases their impact on overall health and productivity. The whole becomes greater than the sum of its parts," they add.

You might ask what PTs can provide from a safety and wellness perspective? There are a host of occupational health services you can provide to your local employers. Workers may be staying on the job longer and delaying retirement due to collapsed 401(k) plans and dwindling savings, this is particularly important for the baby boomers who are likely to work well into their late 60s and 70s. The following services are targeted to all workers, including newly hired and very experienced or "seasoned" workers, with most crossing the line between safety and wellness:

- Functional Job Analysis to understand the work being performed, identify risks and identify potential ergonomic improvements that could be made.
- Functional Job Descriptions to identify the essential functions and critical demands of the jobs to assist with the hiring and return to work processes.
- Pre-work or Pre-employment Functional Screens to make sure workers have the ability to safely perform the functional aspects of the job day one.
- New Hire Training to assist new hires remaining fit and safe on the job through education specific to fitness, biometrics, proper nutrition, hydration, use of micro stretch breaks, etc.
- Job Coaching to observe workers performing their job duties at their work station and provide needed coaching education specific to proper body alignment and optimum positioning to avoid needless stress and strain.
- Individual and Group Prevention related to a specific job or group of jobs, involving one worker or group of workers.
- Preventive Care including Early Intervention Screening/ First Aid to reduce reported discomfort and improve job performance.
- Physical/Occupational Therapy at the workplace with a focus on stay at work when possible to decrease lost work days.
- Functional Testing along with Work Specific Conditioning to assist return to work/stay at work following injury/ illness.

Much evidence already exists to prove that a safer workforce is a healthier workforce, but the converse may be true too: that the healthier workforce may be a safer workforce. More studies need to be performed. But in the meantime, PTs have a place at the table to link safety and wellness.

REFERENCES

1. Hymel PA, Loeppke RR, Baase CM, et al. Workplace health protection & promotion: a new pathway for a healthier--and safer--workplace. *J Occup Environ Med*. 2011;5(6):695-702.
2. Definition of Wellness. http://definitionofwellness.com/. Accessed November 27, 2012.
3. Corbin CB, Welk GJ, Corbin WR, Welk KA. *Concepts of Fitness and Wellness: A Comprehensive Lifestyle Approac*h. 8th ed. McGraw-Hill Companies, Inc.; 2008.

Margot Miller, PT, VP Provider Solutions for WorkWell Systems in Duluth MN, can be reached at mmiller@workwell.com. She currently serves as the president of the OHSIG and is on the Advisory Council for OPTP. Photos are courtesy of WorkWell Systems, www.workwell.com, Duluth MN.

PERFORMING ARTS

SPECIAL INTEREST GROUP

PRESIDENT'S MESSAGE

The PASIG is excited about our upcoming programming on Wednesday, January 23, 2013 in San Diego. This year we chose to evaluate our dancers along with other repetitive athletes, such as runners and jumpers, in an effort to compare their injuries. This presentation will provide insight on the latest research related to the treatment of tendinopathies. The presentation will be as follows: **Dancers, Runners, Jumpers: Same Diagnoses, Similar Presentations—Unique Interventions? Part 1: Low Back Pain and Patellar Tendinopathy, Part 2: Achilles Tendinopathy.**

Speakers: Jo Armour Smith, PT, MManTher, OCS; Kornelia Kulig, PT, PhD, FAPTA; Krissy Sutton, PT, DPT, ATC from University of Southern California

In our efforts to assist performers in finding therapists across the country, we have created a database that can be searched to find a Performing Arts PT. To be listed in this database, please update your PASIG membership profile at https://www.orthopt.org/surveys/membership_directory.php.

The Orthopedic Section is working to enhance the delivery method of continuing education information and they have contracted Publishers Communication Group in Boston to assist with this process. Please stay tuned for upcoming information regarding this in January 2013. Please note that you can continue to purchase the performing arts specific home study courses at www.orthopt.org.

Sincerely,
Julie O'Connell, PT, DPT, ATC
PASIG President

PASIG SESSION AT CSM

Make sure to include PASIG Programming for CSM 2013 in San Diego. It will be excellent information for PTs and PTAs working with performing artists, but will also be very relevant to clinicians working with other athletes. We hope to see you there!

PASIG members – Our annual Business Meeting will be held in this location from 12:00-1:00 p.m. at the conclusion of the continuing education content. Be sure to join us for the meeting!!

Here is the information about the PASIG programming at CSM 2013:

Wednesday, January 23

Dancers, Runners, Jumpers: Same Diagnoses, Similar Presentations—Unique Interventions? Part 1: Low Back Pain and Patellar Tendinopathy - Part 1 8:00-10:00 a.m. (check on site program for location)

Dancers, Runners, Jumpers: Same Diagnoses, Similar Presentations—Unique Interventions? Part 2: Achilles Tendinopathy 11:00 a.m. – 12:00 p.m.

Speakers: Jo Armour Smith, PT, MManTher, OCS; Kornelia Kulig, PT, PhD, FAPTA; Krissy Sutton, PT, DPT, ATC from University of Southern California

This session will establish a biomechanical and motor control framework for the assessment and treatment of athletes who are dancers, runners, and ball players. It will provide sound, exercise science-based rehabilitation programs for these athletes using case study examples, and will discuss the process of designing an intervention program that addresses the needs of an individual athlete. Each case will have instrumentally and observationally based movement analyses that will guide the intervention. The presentations will emphasize translating the current "best evidence" to clinical practice.

PASIG Business Meeting – 12:00-1:00 p.m. - same location as continuing education and will immediately follow the end of the educational programming.

PERFORMING ARTS RESOURCES

Orthopaedic Section-American Physical Therapy Association, Performing Arts SIG
http://www.orthopt.org/content/special_interest_groups/performing_arts
Performing Arts Citations and Endnotes
http://www.orthopt.org/content/special_interest_groups/performing_arts/citations_endnotes

ADAM Center
http://www.adamcenter.net/
Publications:
http://www.adamcenter.net/#!vstc0=publications
Conference abstracts:
http://www.adamcenter.net/#!vstc0=conferences

Dance USA
Annual Conference: Philadelphia, PA, June 12-15, 2013
http://www.danceusa.org/
Research resources:
http://www.danceusa.org/researchresources
Professional Dancer Annual Post-Hire Health Screen:
http://www.danceusa.org/dancerhealth

Dancer Wellness Project
http://www.dancerwellnessproject.com/
Becoming an affiliate:
http://www.dancerwellnessproject.com/Information/BecomeAffiliate.aspx

Harkness Center for Dance Injuries, Hospital for Joint Diseases
http://hjd.med.nyu.edu/harkness/
Continuing education:
http://hjd.med.nyu.edu/harkness/education/healthcare-professionals/continuing-education-courses-cme-and-ceu
Resource papers:
http://hjd.med.nyu.edu/harkness/dance-medicine-resources/resource-papers-and-forms
Links:
http://hjd.med.nyu.edu/harkness/dance-medicine-resources/links
Informative list of common dance injuries:
http://hjd.med.nyu.edu/harkness/patients/common-dance-injuries
Research publications:
http://hjd.med.nyu.edu/harkness/research/research-publications

International Association for Dance Medicine and Science (IADMS)
http://www.iadms.org/
Resource papers:
http://www.iadms.org/displaycommon.cfm?an=1&subarticlenbr=186
Links:
http://www.iadms.org/displaycommon.cfm?an=5
Medicine, arts medicine, and arts education organization links:
http://www.iadms.org/displaycommon.cfm?an=1&subarticlenbr=5
Publications:
http://www.iadms.org/displaycommon.cfm?an=3
Upcoming Meeting:
23rd Annual Meeting: October 17-20, 2013 in Seattle, Washington.

Performing Arts Medicine Association (PAMA)
http://www.artsmed.org/
Annual symposium: July 20-23, 2013 Medical Problems of Performing Artists: "Maximizing Performance, Artistry, Implementation, and Empowerment" in Snowmass, Colorado.
http://www.artsmed.org/symposium.html
Interactive bibliography site:
http://www.artsmed.org/bibliography.html
Related links:
http://www.artsmed.org/relatedlinks.html
Member publications:
http://artsmed.org/publications.html

PAIN MANAGEMENT

SPECIAL INTEREST GROUP

President's Message

Time has a sure way of moving on and getting away from me. It is hard to believe that CSM will be coming up soon. This year's PMSIG programming will be on Wednesday, January 23, 2013. The first session will be from 8:00 a.m. to 10:00 a.m. titled, "Taijiquan in Rehabilitation: Ancient Tradition, Modern Evidence." This lecture will discuss the use of Taijiquan (also known as Tai Chi Chuan) as a rehabilitation modality with research evidence of its effects on pain, disability, self–efficacy, strength, balance, density, and cardiovascular effects. The discussion will include principles that can be incorporated into a rehabilitation plan with a focus on the management of pain conditions. The presenter will be Michael Costello from the Orthopedic Physical Therapy Residency Program, Cayuga Medical Center, Ithaca, NY.

The second presentation will be from 11:00 a.m. to 12:00 p.m. titled, "Essential Pain Knowledge for Physical Therapists: Recommendations from the International Association for the Study of Pain." This session will provide an overview regarding the role of the physical therapy management based on the recommendations from the International Association for the Study of Pain including members of the IASP curriculum task force. Content topics will include the nature of pain, pain assessment and measurement, management, and clinical conditions with innovative strategies for patient and student education. The presenters will be Marie Hoeger Bement from Marquette University and Mary Beth Geiser from the University of Iowa.

The PMSIG Business Meeting will be immediately after the presentations from 12:00 to 1:00 p.m.

CORRECTION TO OP PMSIG NEWSLETTER. The article written by Carolyn McManus contained an error. The end of the article #6 of Clinical Implications of SIH should read "Physical therapists providing standard physical therapy treatment combined with a psychosocial intervention to patients with subacute low back pain (not chronic) was shown to reduce risk factors for pain and disability, reduce the use of the health care system, reduce the use of pain medications, and improve return-to-work outcomes.

UNUSUAL REQUEST. Like many of you, some unusual requests stand out in my mind. This past spring, I received a call from a lady who wished to have laser treatment to acupuncture points to help her stop smoking. She had been evaluated by a chiropractor, located 75 miles away from her home, who agreed to treat her with laser to acupuncture points and provide her with supplements to decrease her smoking cravings for a mere $8,000. She informed me that she was 69 years old and smoked 1 to 2 packs of cigarettes per day since she was 21 years old. She had COPD, CAD, as well as chronic arthritis in her hips and knees. I informed her that this treatment did not really fall within the scope of my State's Practice Act, except as a possible wellness program, but I would be willing to try laser for smoking cessation to get a feel for its efficacy. I agreed to see her two times per week for 4 weeks at no cost as I wanted to further my knowledge of uses for laser treatment. There was no cost to her as I wanted to remove the "green poultice" effect from the project. (For those of you who have less gray hair than I, the green poultice effect simply is the more money (green poultice) you apply to a treatment, the more a person may believe that the treatment helps.) My state has practice without referral for 12 visits, so I was within legal practice limits.

Her treatment plan was to stimulate bilateral auricular points (Lung 2, Shen Men, Autonomic Point, Liver, and C. Kidney) and 2 points on each wrist (Tim Mee and Lung 7) with a 904 Nm infrared laser. Treatment time on each point was based on the vaso autonomic response of the Radial Artery at the wrist. After the second treatment, her cravings for cigarettes were reduced to 10 cigarettes per day. Cravings continued to be reduced until she quit completely by the 7th treatment and she has remained tobacco free for the past 6 months. I love it when a plan comes together.

Hope to see you at CSM. Have a wonderful Holiday Season,
John

IMAGING

SPECIAL INTEREST GROUP

IMAGING EDUCATION ACTIVITY FOR 2012

Membership: The ISIG continues to grow with 166 members. Three nominees were recruited to serve as members of the Nominating Committee.

ISIG area of Section Web site: ISIG Directory and ISIG listing are up on the Section Web site.

Resource for imaging in physical therapy: Worked with APTA staff on language for practice guidance and responded to frequent member inquires on imaging and physical therapist practice.

Curriculum guidance for imaging in PT education: Steering committee of Drs. Bill Boissonnault, Wayne Smith, and Douglas M. White have been working on a survey to submit to PT education programs pertaining to imaging content addressed within curricula. Survey is developed and has been sent out for responses. Interim report will presented at CSM 2013.

Research Committee: Dr. Paul Beattie has been appointed chair of the newly formed Research Committee. Look for future updates as this committee get up and running.

CSM 2013: Two imaging programs are planned for CSM in San Diego: "Using the 'Diagnostic Image' Tool in Your Tool Box – Clinically Relevant Radiology," and "Evidence-based Practice of Musculoskeletal Imaging in Orthopaedic Physical Therapy: Hips."

American Institute of Ultrasound in Medicine (AIUM): Douglas M. White has continued to represent the APTA to the AIUM for the development of Point-of-Care US Guidelines. These guidelines are still in draft form. Hopefully they will be published over the next year.

DO YOU HAVE INTERESTING IMAGING INFORMATION TO SHARE?

Please consider contributing to the newsletter. Items of interest around imaging in PT practice, education, and research are welcome. Send your ideas to dr.white@miltonortho.com.

WE ARE GROWING! JOIN US!

The NEW Orthopaedic Section Imaging Special Interest Group (ISIG) is growing! We are excited that so many individuals have joined our new SIG in such a short period of time. Please join the Imaging SIG by visiting the ISIG section of the Orthopaedic Section Web site.

Imaging Special Interest Group Officers

President
Douglas M. White, DPT, OCS
(follow at: @Douglas_M_White)

Vice President
Deydre Teyhen, PT, PhD, OCS

Nominating Committee
Judy Woehrle, PT, PhD, OCS Chair
James Elliott, PT, PhD
Wayne Smith, DPT, SCS

ANIMAL REHABILITATION

SPECIAL INTEREST GROUP

PRESIDENT'S NOTE

I hope that this holiday season has found you well and that you, like me, are looking forward to a fabulous 2013. I have no choice but to reflect on these past 6 years as my term as ARSIG President draws to a close. I can't deny that the path that I've followed over these years has led me to grow both personally and professionally. Many of you who know me so well will agree that I'm a 'planner,' a list-maker, and a Type A through and through. This makes it even more amazing that this path that I've followed has had such twists, turns, bumps, and rough spots—and yet so "worth the trip." Some events that come to mind: motherhood, pursuing a tDPT, moving my family more than 500 miles from my adopted home state of Maryland to Massachusetts, the recession…

Similarly, the field of animal rehabilitation, or shall I say, "physical therapy for animals," has had its own 'off road experience' over these past years. Legislative challenges, turf wars, the recession…

My professional role has changed as well—from employee, to employer, to contractor, to manager, to solo practitioner, to team member. I've learned much from physical therapy colleagues and mentors as well as veterinary technicians, veterinarians, and veterinary specialists—though just as much from my patients and clients. The field of "physical therapy for animals" will continue to grow. My only hope is that those of us who have been along for the ride for a bit will mentor and nurture the future generation of physical therapists and assistants who will be so fortunate as to have animals as patients. Never have I known a day's work to be so rewarding.

So long, farewell, auf Wiedersehen, goodbye. It's been a fun ride.
Amie

CSM IS COMING

Mark your calendars for January 20-24, 2013 and head to San Diego for CSM! The ARSIG has been granted a preconference course for the first time, so please support this effort! The course is entitled "Manual Therapy for Mechanical Dysfunctions of the Canine Lumbar Spine: Human and Canine Comparisons," presented by Cindy McGregor, PT, PhD, OCS, and Laurie Edge-Hughes, BScPT, M.AnimSt, CAFCI, CCRT. The ARSIG also has its regular programming during the conference. This year, the topic is "Measuring Change in Canine Rehabilitation: Outcome Tools for Clinicians," and is presented by Cindy McGregor, PT, PhD, OCS, and Amie Hesbach, PT, MSPT, CCRP, CCRT. Part 1 runs 8-10 a.m., Part 2 runs 11-1 p.m., with the ARSIG business meeting immediately following.

Newsletter Coordinator's Note: ***Amie Hesbach has graciously submitted a sample of an intake form that can be used with your canine rehabilitation patients. This is a very comprehensive form that covers demographic information, past medical/surgical history, medications, and potential red flags. Many thanks to Amie for sharing this with the Animal Rehabilitation SIG readers.***

Screening for Medical Disorders
Amie Lamoreaux Hesbach, MSPT
November 5, 2012

Caregiver Health History Questionnaire for Small Animal Rehabilitation

To ensure that your pet receives a complete and thorough evaluation, please provide us with the following important background information. If you do not understand a question, please leave it blank and your pet's therapist will assist you. Thank you!

PET'S NAME:_____ YOUR NAME:_____

BREED:_____ AGE: _____

SEX: M / F SPAYED OR NEUTERED: YES / NO

Reproductive History

If spayed or neutered, at what age? _____

If female, number of litters? _____ Size of litters? _____

If female, age at first heat cycle? _____

Activity/Social History

When did you adopt your pet?_____ From where/whom? _____

Has your pet ever travelled to another state or country? YES / NO

If yes, please specify where and when: _____

Leisure activities (prior to this injury/surgery): _____

Does your pet have a job? (Specifically, a therapy pet, service animal, etc.) _____

Does your pet participate in any type of competition? (Specifically, agility, field trial, conformation, etc.) _____

Is your pet regularly exposed to tobacco smoke? YES / NO

What percentage of the day does your pet spend indoors? _____ Outdoors?_____

Has your pet had any formal obedience training? YES / NO

Is your pet boarded when you travel? YES / NO

Has your pet ever attended doggie day care, gone on group dog walks, or visited a dog park? YES / NO

Does your pet have any diagnosed or suspected allergies or sensitivities (ie, food, environmental, or other)? YES / NO

If so, please specify: _____

Medical History

Please check (✓) any of the following who have ever provided medical care for your pet:

- ☐ Acupuncturist
- ☐ Cardiologist (DVM/DACVIM)
- ☐ Chiropractor (DC)
- ☐ Dermatologist (DVM/DACVIM)
- ☐ Surgeon (DVM/DACVSS)
- ☐ Internal Medicine Specialist (DVM/DACVIM)
- ☐ Massage Therapist
- ☐ Neurologist (DVM/DACVIM)
- ☐ Oncologist (DVM/DACVIM)
- ☐ Physical Therapist (PT)
- ☐ Rehabilitation Veterinarian (DVM/DACVSMR)
- ☐ Other Rehabilitation Practitioner (CCRP/CCRT)
- ☐ Other: _____

Date of last physical examination by your pet's regular veterinarian: _____

If your pet has seen any of the above during the past three months, please explain the reason (ie. illness, medical condition, physical, etc.):

_____

_____

Has your pet EVER been diagnosed as having any of the following conditions?

YES NO Cancer. If YES, what kind: _____

YES NO Heart problems. If YES, please describe: _____

YES NO Tick-borne diseases (Lyme, Erlichiosis, Baseosis, Rocky Mountain Spotted Fever, Anaplasmosis)

YES NO Breathing problems. If YES, please describe: _____

YES NO Gastrointestinal problems. If YES, please describe: _____

YES NO Thyroid problems.

YES NO Diabetes.

YES NO Autoimmune disorder. If YES, please describe: _____

YES NO Osteoarthritis.

YES NO Neurological disorder. If YES, please describe: _____

YES NO Intervertebral disc disease.

YES NO Stroke or fibrocartilagenous embolism (FCE).

YES NO Kidney disease. If YES, please describe: _____

YES NO Blood clotting disorder. If YES, please describe: _____

YES NO Other _____

Please list any surgeries or other conditions for which your pet has been hospitalized, including the approximate date and reason for the surgery or hospitalization:

Surgeries/Hospitalizations (Include Date and Reason)

1. _____
2. _____
3. _____
4. _____
5. _____

Please describe any significant injuries for which your pet has been treated (including fractures, dislocations, sprains) and the approximate date of injury:

Injuries (Include Date of Onset)

1. _____
2. _____
3. _____
4. _____
5. _____

Which of the following medications have you given to your pet in the past week?

Pain medications (Tramadol, Gabapentin, Amantadine, etc.)	YES / NO
Anti-inflammatories (Deramaxx, Metacam, Rimadyl, etc.)	YES / NO
Vitamin/mineral supplements	YES / NO
Herbal remedies	YES / NO
Others NOT prescribed by a veterinarian _____	YES / NO

Please list any other veterinarian-prescribed medication you are currently giving your pet (INCLUDING pills, injections, and/or skin patches. Please include dosage and frequency.)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Is your pet up to date on his/her vaccinations?	YES / NO
If not, do you ask your veterinarian to titer your pet?	YES / NO
Do you give your pet a monthly heartworm preventative?	YES / NO
Do you give your pet a monthly flea or tick preventative?	YES / NO

Please circle any of the following that are NEW, UNUSUAL, or ATYPICAL for your pet.

YES / NO	weight loss/gain	YES / NO	joint/muscle swelling
YES / NO	vomiting	YES / NO	easy bruising
YES / NO	fatigue	YES / NO	excessive bleeding
YES / NO	weakness	YES / NO	panting
YES / NO	excessive grooming	YES / NO	coughing
YES / NO	tremors	YES / NO	eye redness
YES / NO	seizures	YES / NO	skin rash
YES / NO	excessive itching/scratching	YES / NO	constipation/diarrhea
YES / NO	pacing	YES / NO	blood in stools
YES / NO	vision problems	YES / NO	blood in urine
YES / NO	increased whining/barking	YES / NO	restless sleep
YES / NO	hearing problems	YES / NO	fecal incontinence
YES / NO	anxiety	YES / NO	urinary incontinence

Therapist signature _____ Date _____

Client signature _____ Date _____

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