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In this issue

Regular features

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Managing Editor & Advertising
Sharon L. Klinski
Orthopaedic Section, APTA
2920 East Ave So, Suite 200
La Crosse, Wisconsin 54601
800-444-3982 x 2020
608-788-3965 FAX
Email: sklinski@orthopt.org

Editor
Christopher Hughes, PT, PhD, OCS

Book Review Editor
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(608) 788-3982 or (800) 444-3982

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Slippery Rock University
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(724) 738-2757
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ISC Associate Editor:
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Editor's Note

Expectations and Reality: Better or Best!

Christopher Hughes, PT, PhD, OCS, CSCS

This happens all the time in the clinic. We start out with certain notions about what level of ability a patient is in terms of function, healing potential, etc. and we then shoot for the stars! It is just our nature. We always want to do our best and set our goals high in terms of helping the patient. I don't think it is arrogant. Maybe it's confidence or maybe it is just optimism, but in the end of the patient care experience, we often reflect back and will try to reassess, did we get the patient better or did we get them best?! I know before I get letters from all the A students in English (better being the comparative use versus best being the superlative), please bear with me. I am just trying to make a point here! The point is that both the patient and therapist and even the insurer for that matter have expectations. These expectations might be rooted in whether the care was patient-centered, timely, effective, efficient, affordable, or even just safe. They may be consistent but oftentimes divergent. And that is when the fun starts! The evaluation of success is tied to the understanding whether the patient ultimately believes they are better than when they were first evaluated or have achieved the best outcome. Sometimes expectations and realities clash for both parties.

A slight topical digression may add perspective. Let me describe a recent flight my family took over the summer. My expectations were that it would leave on time and fly nonstop as scheduled to my destination. Wow, were we in for a big surprise! Those expectations were missed in a major way when we incurred delays in departing and did not get off the ground until 10 hours later than planned. Wait, it gets better, or worse! An hour into the flight the pilot says, "Just when you thought things couldn't get any worse," (honest, the pilot did say that!) engine failure occurred in one of the newly-installed engines (hence the delay) that required an emergency landing in Kansas City. Hmm, when I purchased my tickets, I don't recall any stop in Kansas City. Ok, now what? To make a long story short, they managed to get another plane in but then we had no crew to fly it! I won't go into detail, but the term *passenger abandonment* may fit well to the scenario. All this led to an overnight stay in Kansas City before finally landing safely in Pittsburgh around noon the next day. Unfortunately, I am sure most of you can relate to this experience if you fly frequently enough! My most basic expectations were not met and the true outcome was way out of line from my preconceptions when purchasing the tickets. Admittedly, the airlines certainly did not plan on this either. However, the discrepancy comes when the airlines and I tried to agree on what the experience was worth or not worth! Bottom line is they did meet my most minimum expectation which was that we arrived uninjured and alive! This is similar to the Latin phrase, *Primum non nocere* meaning *"first, do no harm."* Ok. Thank you, but statistically speaking those odds were in their favor. Most travelers do not have a lot of experience with airlines' refunds, but the airlines know this area all too well and are experts when it comes to putting the lowest redeemable value on the experience. If you have ever tried to get your money back, you know what I am alluding to.

To summarize, I tried to handle the discrepancy as a matter of perspective. You know, letting them know the cost in terms of time, emotional trauma, and certainly the outlay of premium dollars all had to be crafted in a way for them to understand the expectations and realities we faced. Well in this case I was fairly happy with the outcome in reimbursement (it just took a month), but nonetheless the time is lost and we cannot get that back. Will I fly again? Yes? Will it be the same airline? Probably, besides is there a choice? There are only so many options for airline travel. The entire experience was not all an example of unmet expectations. On a positive note, I will say while grounded in Kansas City, the staff did work really hard at accommodating our needs and their efforts "exceeded" my expectation. There was a small silver lining that ironically helped me come to a fair resolution and also see the true empathy that people in this business can demonstrate…thank you, Kansas City!

There are many parallels in this story with patient care. If a patient has had physical therapy before, they have some basic idea of what to expect. Sometimes it's a great experience and sometimes they know exactly what they want to avoid from a previous experience! The type of patient expectation can be felt immediately with the interview. We all know that feeling when it happens. Typical stages of acceptance or non-acceptance when meeting people for the first time. The first impression of the greeting, the initial suspicion of the patient in trying to make sure you are competent, the expectation that you feel empathy, the feeling of acceptance of each other's role, and ultimately, the release of "trusting" you to do the job and get to the BEST outcome. Yes, it comes from both parties (PT and patient) giving and taking a bit to find the balance of BEST. Along the way either party can misstep. Patients can be less than compliant. A therapist can be challenged when symptoms and healing do not go as planned. Now what occurs is a shift from BEST to a maybe "giving in" or "it will do," which becomes a lower level of BETTER! It's a delicate dance indeed and one that is not always handled well by us admitting that we cannot get BEST, and the patient realizing that his or her outcome will just have to take on a sense of reality ("I will live with it").

The articles in this issue all attempt to provide us with "The Best" approach to treatment. Smith and Brewer propose the management of anterior hip pain using a movement system impairment by focusing on restoring precision of hip motion and improving muscle performance of proximal hip stabilizers. Saviola and colleagues advocate cervical spine stabilization exercises in a female patient with cervicogenic dizziness and chronic neck pain following multiple concussions. Bawa proposes Schroth Therapy for scoliosis treatment. Kaplan supports interdependence in treating an adolescent athlete with low back pain.

More than ever, in today's health care environment, we are being held accountable, so we need to make it count and do our best so the patient gets "best." So, one thing can be better than another, but others could still be better. But if one thing is the best, then nothing can be better!

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Management of Anterior Hip Pain Using a Movement System Impairment Approach: A Case Report

Allison Smith, PT, DPT
Wayne Brewer, PT, PhD

Harris Health System, Houston, TX

ABSTRACT

Background and Purpose: There is limited and conflicting evidence regarding conservative treatment of anterior hip pain. Common diagnoses include femoroacetabular impingement (FAI), labral tears, and snapping hip syndrome. The purpose of this case report is to describe the management of a patient with left anterior hip pain using a movement system impairment approach. **Case Description:** A 27-year-old female presented with left anterior hip pain for 2 months after doing multi-directional lunges with weight. Her main functional deficits were pain and difficulty with squats, lunges, and running. She had signs and symptoms of FAI and her primary movement impairment was femoral anterior glide with medial rotation. **Outcomes:** Following a 6-week exercise-based program, the patient displayed decreased pain, improved strength and range of motion, and returned to her previous activities. **Conclusion:** Focusing on restoring precision of hip motion and improving muscle performance of proximal hip stabilizers improved patient function and decreased pain. Addressing movement impairments may be an effective conservative treatment option in patients with FAI.

Key Words: femoral anterior glide with medial rotation, femoroacetabular impingement

BACKGROUND

Hip pain is a common complaint for which people are referred to physical therapy. The prevalence of hip pain in adults over the age of 60 ranges from 9.7% to 19.2%.[1–4] Hip pain in older adults is more likely to be related to osteoarthritis (OA), with the prevalence of OA in adults over age 60 ranging from 0.4% to 27%.[5,6] Hip pain in younger adults without OA or a childhood hip disorder is difficult to diagnose and more research is needed to determine prevalence of hip pain in this population.[7] Abnormal or excessive loading of the hip has recently been recognized as a potential cause of anterior hip pain and subtle hip instability.[8,9] Patients may also have hip pain secondary to generalized ligamentous laxity or abnormal bony architecture and therefore have increased stresses applied to their soft tissue structures.[8] An example of abnormal bony architecture includes femoroacetabular impingement (FAI), which is the result of an abnormally-shaped femoral head and/or acetabulum.[10]

Femoroacetabular impingement is present in 10% to 15% of the population.[11] Knowledge and awareness of FAI as a clinical entity is growing, and symptoms are commonly manifested as insidious groin pain.[12] There are 3 main forms of FAI: pincer, cam, and combined (pincer and cam) impingement. Pincer impingement is caused by an excessive prominence of the anterolateral rim of the acetabulum, while cam impingement is caused by a nonspherical femoral head rotating inside the acetabulum.[13]

The physical stress theory proposes that the excessive stress (stress that exceeds the tissue's tolerance) results in tissue injury and pain.[14] In the case of anterior hip pain, excessive stress may be due to repetitive forces placed on the connective tissues of the anterior hip joint (acetabular labrum).[15] Femoroacetabular impingement can lead to chronic microtrauma to the cartilage and labrum and thus patients often complain of chronic pain that is gradually worsening.[10] Impingement of the proximal femur against or within the acetabular rim is a common underlying cause of a labral tear in the non-dysplastic hip, and clinical signs of FAI have been found in up to 95% of patients with a labral tear.[16,17] Hip instability and excessive hip forces may cause a tear of the acetabular labrum even in the absence of a traumatic event.[9]

Combined hip flexion, adduction, and internal rotation movements (FADIR) along with maximal hip flexion most commonly replicates the pain experienced during anterior hip impingement. This pain is often described as catching, clicking, and a feeling of "giving way."[16] The log roll test is another test that may be specific for FAI. This test involves the examiner rolling the suspected hip back and forth causing the femoral head to rotate within the acetabulum and joint capsule, without stressing the surrounding structures.[13] Hip joint pathology usually does not have accompanying tenderness to palpation.

Hip joint forces are altered by hip joint positions and changes in muscle force contribution. During prone hip extension, the direction of hip joint forces are affected when the gluteal muscles are weakened and the hamstring muscles compensate causing increased compression at the hip joint.[18] Similarly, both the osteokinematics and arthrokinematics of the hip joint change during supine hip flexion activities if muscles that insert more distal to the hip joint such as the rectus femoris or tensor fascia lata (TFL) are more dominant than the proximally inserted muscle groups such as the iliopsoas, particularly if they are weak. This change in the relative contribution of muscle activity to produce movement at the hip joint results in a relatively unstable axis of rotation. In patients with anterior hip pain, the hip medially rotates during supine hip flexion suggesting that the action of the TFL is dominant over the iliopsoas muscle.[9,19] These pathomechanical impairments promote excessive femoral anterior glide and medial rotation.

Femoroacetabular impingement has been considered to be a possible predisposing factor for idiopathic hip joint OA.[10,20,21] Prevention and conservative management of FAI, anterior hip impingement, and labral tears are conflicting. There are currently no formal prevention programs for FAI, and there is limited research regarding appropriate or effective physical therapy interventions for individuals with suspected labral tears or FAI.[9,13,17,22] The 2014 clinical practice guideline on nonarthritic hip joint pain recommends interventions such as patient education, manual therapy, therapeutic exercise, and neuromuscular re-education, but the strength of the evidence for all of the recommended interventions are at the level of expert opinion.[23] Ganz et al[21] reports that surgical attempts to restore normal anatomy to avoid FAI should be performed in the early stage before major cartilage damage is present. Surgery is the current mainstay of treatment, and there are a variety of surgical interventions used to treat FAI ranging from least invasive arthroscopy to the most

invasive open surgical dislocation.[10,16] Yazbek et al[17] reports that patients with clinical evidence of a labral tear can show meaningful improvement with conservative intervention. However, Byrd and Jones[24] report that FAI is not necessarily a cause of hip pain; it is simply a morphologic variant and hips may possess the morphologic features of FAI without developing the cartilage failure associated with pathologic impingement. There are previous reports that suggest end range hip flexion such as squatting should be eliminated completely to avoid anterior hip impingement, while others suggest avoiding excessive hip and knee extension during gait to decrease stress on anterior hip structures.[9,10,13,15]

While physical therapists cannot change the morphology of the hip joint, they can address movement impairments, muscle strength deficits, and certain aspects of joint range of motion to decrease stresses on the anterior hip joint. Many of the interventions described in this case report are based on the diagnosis and treatment of movement system impairment syndromes described by Shirley Sahrmann, PT, PhD.[19] The movement system impairment approach places less emphasis on identifying the source of the symptoms and more on identifying the pathomechanical cause. This approach presumes that the problem occurred because patterns of movement were impaired before joint movement became painful or restricted. The loss of precise movement can begin a cycle of events that induces changes in tissues that progress from microtrauma to macrotrauma. The main premise of the movement system approach is to maintain or restore precise movement of specific segments to prevent or correct musculoskeletal pain.

The movement system-based examination attempts to identify all the factors contributing to movement pattern impairments and provides the basis for determining corrective exercise. When the patient fails a part of the examination, the test item or modification of the item is used as part of their therapeutic exercise program. Addressing the pathomechanical source of pain contributes to a more complete and enduring correction and allows the patient to understand how to control the factors producing his or her symptoms. It can also help the patient assume an active role in the treatment and prevention and have a greater capacity for improved functional outcomes as compared to passive approaches.

This case report specifically describes a patient with femoral anterior glide with medial rotation syndrome, defined as:

- A primary movement dysfunction of excessive anterior glide and medial rotation of the femur during hip flexion.
- An impaired path of instantaneous center of rotation (PICR) of the hip joint occurs as indicated by upward and medial movement of the greater trochanter during hip flexion.
- Failure of the external rotation component of the iliopsoas to counteract the medial rotation produced by the TFL.
- Stiffness of the posterior hip joint structures and the excessive flexibility of the anterior hip joint structures as the result of maintained hip extension create a path of least resistance promoting anterior glide.

Common medical diagnoses in patients with femoral anterior glide with medial rotation syndrome include acetabular labral tear, FAI, iliopsoas tendinopathy or bursitis, snapping hip syndrome, and sacroiliac dysfunction.

The purpose of this case report is to describe the management of a patient case using a movement system impairment approach to treat anterior hip pain.

CASE DESCRIPTION

The patient was a 27-year-old female who reported left anterior hip pain in July 2014 after doing multi-directional lunges with weight. She continued to perform the exercise despite the pain, but with less weight. After one week, she discontinued the multi-directional lunge but continued to perform deadlifts, squats to 90°, and other upper body/core work. She was also doing sprinting/walking interval training prior to her injury. She discontinued running and much of her resistance training in August 2014 due to pain. Before July 2014, she was painfree but did have symptoms of clicking, snapping, and pinching in both hips. When the patient was evaluated in October 2014, she had not had any type of medical intervention or radiographic examination for her hip pain. She was taking over the counter nonsteroidal anti-inflammatory drugs to manage her pain and also tried modifying her activities without success.

Growing up, the patient played softball and volleyball, often staying in a squat position for a majority of the games. At the time of evaluation, the patient was participating in a dance fitness class one time a week. The patient reported no other musculoskeletal injuries other than a history of bilateral ankle sprains with the most recent sprain occurring in May 2013. The patient had no other relevant medical conditions and review of systems was unremarkable.

Prior to her onset of symptoms, she was able to lift weights and perform sprinting/walking interval training without pain. The patient's main goal was to return to lifting weights while doing squatting and lunging movements without pain. She stated she would also like to lose weight and improve overall conditioning and strength.

Clinical Examination

The examination began with a postural assessment and movement analysis. The patient stood with a swayback posture and displayed increased hip medial rotation on the left compared to right (Figure 1). She also had increased pronation bilaterally as well as a positive "too many toes" sign. Cardinal plane range of motion (ROM) of the lumbar spine was normal and painfree. The patient displayed adequate hip flexion ROM during forward bending but the majority of the motion came from her thoracic and lumbar spine (see Figure 1). During gait, the patient reported no pain but displayed increased hip medial rotation during swing phase and a positive Trendelenburg sign bilaterally.

During single leg stance, the patient displayed contralateral hip drop during single leg stance bilaterally, increased hip medial rotation on the left, and decreased balance on the left. The patient was then asked to perform a squat. She was able to squat just past 90° of hip flexion, but displayed increased forward trunk flexion and reported pain at end range. Hip flexion ROM at her end range squat was 104° and knee flexion ROM was 92°. While performing a single leg squat, the patient had difficulty balancing and displayed decreased squat depth and increased hip medial rotation bilaterally. While assessing prone hip extension with the knee extended, the patient recruited her hamstrings before her gluteal muscles on both sides as determined by palpation. When asked to perform quadruped rocking backward, the patient displayed significant lumbar and thoracic flexion. When cued to increase hip flexion, the patient was unable to rock back as far and reported pain and pinching in both hips, with the left being more painful.

Following the movement analysis, ROM and manual muscle testing (MMT) was performed. Range of motion was measured in degrees using a standard goniometer. Manual muscle tests were graded on a 5-point scale and MMT positions were used as described by Kendall et al.[25] The iliopsoas was tested in sitting and the ankle plantar flexors were

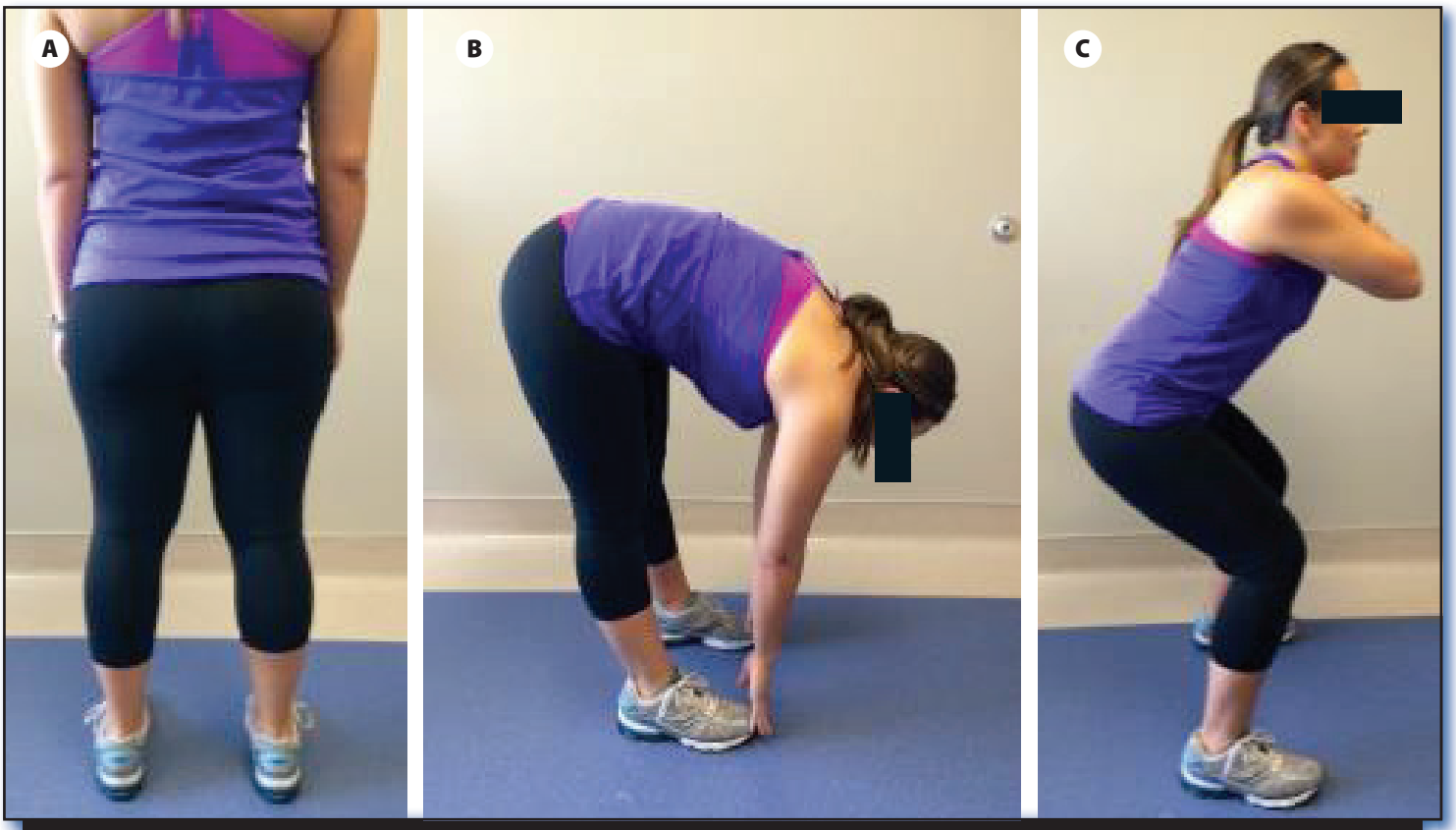

Figure 1. A, The patient stands with increased hip medial rotation. B, The patient displays increased motion in her thoracic and lumbar spine. C, The patient's initial squat depth was limited due to pain.

graded in standing using the heel raise method as described by Hislop et al.[26] The lower abdominals were given a muscle grade as described by Sahrmann et al.[19] Results are listed in Tables 1 and 2. The patient displayed decreased hip flexion passive ROM and an empty endfeel bilaterally, with more limitations of the left hip (90°) compared to the right hip (102°). The patient also displayed increased hip external rotation ROM on the left (52°) compared to the right (50°). Despite her limited hip flexion ROM, the patient displayed overall hypermobility throughout the exam and had 8/9 Beighton score for increased ligamentous laxity.[27] Strength deficits were noted bilaterally in the iliopsoas, ankle plantar flexors, abdominals, and gluteus medius.

The patient was found to have no muscle length impairments of hip flexors or hamstrings after performing the two joint hip flexor length test (modified Thomas test) and the 90/90 hamstring test.[19] The anterior hip impingement test (FADIR) was positive for pain bilaterally. During the active straight leg raise (SLR) test as described by Sahrmann et al,[19] the patient displayed anterior glide and medial rotation bilaterally as determined by palpation and observation.

After the examination, the patient was given a physical therapy diagnosis of femoral anterior glide with medial rotation according to the movement system impairment classification system.[19] The patient displayed muscle weakness bilaterally in her gluteals, abdominals, and iliopsoas and stood in a slight swayback posture. She also displayed general hypermobility throughout the examination except when assessing hip flexion ROM that was limited due to shortness and a lack of flexibility in the gluteal muscles combined with muscle guarding. This was hypothesized according to the examiner in order to prevent pinching in the anterior hip. Finally, she displayed a faulty PICR during active hip flexion as determined by the active SLR test. Instead of the greater trochanter maintaining a stable axis of rotation during the active SLR test, it moved anteriorly and medially.

OUTCOMES

The patient was given a 6-week mesocycle training program to improve strength, endurance, and muscle recruitment patterns. The mesocycle was composed of 3 microcycles, with each microcycle lasting 2 weeks (Tables 3, 4, and 5). All exercises are described in Table 6. The patient was given her first two microcycles one day after initial evaluation. She was instructed on all exercises and verbally consented to the treatment plan. If she had any questions or concerns, she was instructed to call or email. The patient was unable to attend weekly visits but was able to attend a follow-up visit in the clinic at the end of the third week, where the patient was given her final microcycle one day later.

Exercises were chosen to address the strength, ROM, and movement impairments found during initial evaluation. The main goals of treatment were to restore precision of hip motion and improve muscle performance of the iliopsoas and posterior hip muscles (gluteus medius, gluteus maximus, and hip lateral rotators).

Part of the mesocycle included aerobic exercise, so the patient's target heart rate was calculated for both interval training (85-90% heart rate reserve [HRR]) and long slow distance training (75% HRR) using the Karvonen method as described by Baechle et al.[28] The patient's target heart rate (HR) during interval training was calculated to be 173-178 beats per minute (bpm) and for long

Table 1. Passive Range of Motion

	Initial Evaluation		1st Reassessment	
	Left	Right	Left	Right
Hip Internal Rotation*	49° with anterior hip pain	50°	50°	50°
Hip External Rotation*	52° with anterior hip pain	50°	55°	50°
Hip Flexion†	90° with anterior hip pain and guarding	102° with anterior hip pain and guarding	120°	125°
Ankle Dorsiflexion†	10°	10°	Not tested	Not tested

*measured in sitting, †measured in supine

Table 2. Manual Muscle Testing

	Initial Evaluation		1st Reassessment		2nd Reassessment	
	Left	Right	Left	Right	Left	Right
Iliopsoas	4-/5 with anterior hip pain	4/5	4-/5 with anterior hip pain	5/5	5/5	5/5
Ankle plantar flexors*	4/5	4/5	4/5	5/5	5/5	5/5
Abdominals†	Level 0.5		Level 1b		Level 1b	
Gluteus medius	3-/5‡	3-/5§	4/5	4+/5	4+/5	4+/5
Gluteus maximus	5/5	4+/5	5/5	5/5	Not tested	Not tested

The following were graded 5/5 at initial evaluation: hip internal and external rotators, tibialis anterior.
*graded as described by Hislop et al[26]
†graded as described by Sahrmann et al[19]
‡with substitutions into hip flexion and lumbar rotation
§with substitutions into hip hiking and hip flexion

slow distance was calculated to be 153 bpm. The calculations are listed in Table 7.

At the end of week 3, a reassessment was performed. The patient stated she was partially compliant with the mesocycle, performing the exercises only 2 to 3 times a week due to time constraints. A movement analysis of the quadruped rocking backward motion was assessed, and the patient was able to keep her back flat and displayed increased hip flexion ROM. When asked to perform a squat, the patient reported no pain on descent but did have left hip pain when returning to standing. Her squat depth was re-measured on the left and she was found to have hip flexion ROM of 120° and knee flexion ROM of 108°.

Range of motion and MMT measurements were taken and are listed in Tables 1 and 2. The patient demonstrated a significant increase in hip flexion ROM at reassessment (120° left, 125° right) compared to initial evaluation (90° left, 102° right). She presented with decreased muscle guarding with endfeel and improved tissue extensibility of the gluteals as determined during assessment of hip passive ROM. The patient also demonstrated an improvement in muscle strength of the iliopsoas, ankle plantar flexors, abdominals, and gluteals by one half to a full muscle grade.

The patient still displayed a positive anterior hip impingement test bilaterally. During the active SLR test, the patient displayed femoral anterior glide and medial rotation with active motion, but it was significantly decreased from initial evaluation as determined by palpation and observation. The patient's final microcycle was created after reassessment and the patient was instructed in the new exercises.

At the end of 6 weeks, a second reassessment was conducted. The patient stated she was now able to perform a full squat and was also able to perform a piriformis stretch for the first time in months (Figures 2 and 3). The patient reported she had been squatting with a weight bar during week 6 without pain. She was also able to perform power cleans and cleans to press. The patient had not yet attempted walk/run intervals, but was able to perform step ups from a 12" step for aerobic exercise.

Select objective measures were reassessed. When the patient was asked to perform a squat, she demonstrated full ROM and was able to lift a bar (weighing 45 pounds) from the ground without pain. The patient still had a positive anterior hip impingement test bilaterally. During the active SLR test, the patient no longer displayed a faulty PICR or femoral anterior glide. Finally, the patient again displayed increased muscle strength of the iliopsoas, ankle plantar flexion, abdominals, and gluteus medius.

At 9-month follow up, the patient completed the Global Rating of Change Scale (GROC) and scored the overall condition of her hip as a 6, which correlates with the statement "a great deal better."[29] A score of 5 or higher is considered a meaningful improvement on the 15-point scale (-7 to 7).[30] The patient reported she returned to all previous exercises without pain and was training for a sprint triathlon. She was exercising 5 times a week and was swimming, biking, running, weight lifting, and doing plyometrics. She had not been doing the mesocycle exercises but recently went back to doing two of them (Cumberford hip series and hip flexor progression, see Table 7) after having minimal pain following running, which resolved after doing the exercises.

DISCUSSION

This case report describes the management of a patient with symptoms consistent with FAI using a movement system impairment approach. The patient's primary movement dysfunction was excessive femoral anterior glide and medial rotation during hip flexion. The excessive flexibility of the anterior hip joint structures as the result of maintained hip extension (such as standing in a swayback posture) created a path of least resistance of anterior glide. Despite having a 5/5 MMT grade in hip medial and lateral rotators, she presented with impaired neuromuscular control of the hip lateral rotators, highlighted by their inability to counteract the hip medial rotators during movement.

The movement system impairment approach to the exercise prescription had a positive impact on the patient's pain and function. The key components of the evaluation that led to the diagnosis of femoral anterior glide with medial rotation were the postural assessment and movement screen.

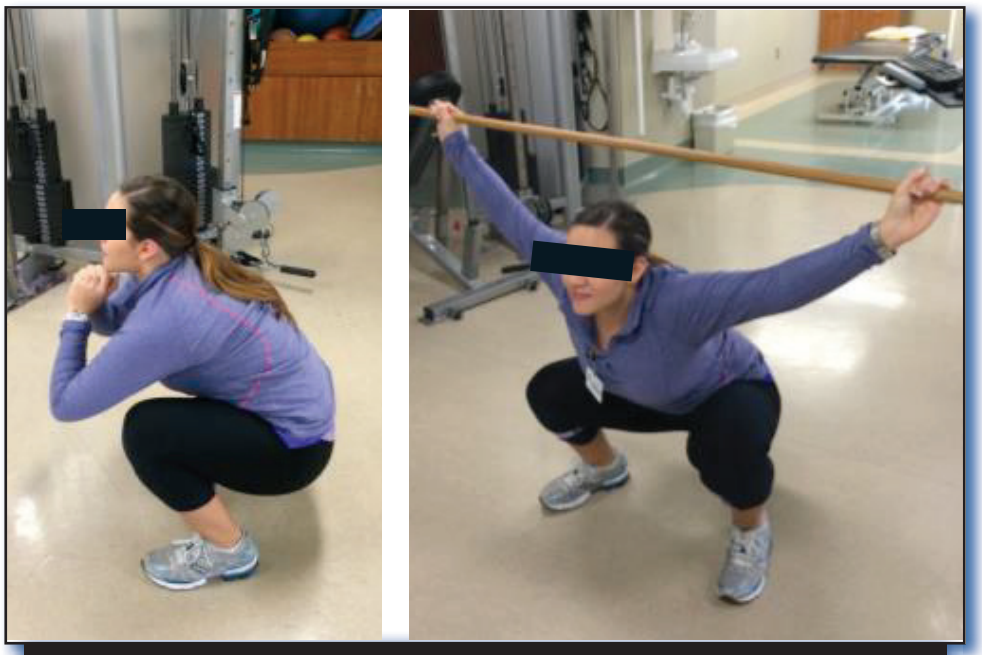

Figure 2. The patient demonstrates improved squat depth at final reassessment.

Figure 3. The patient demonstrates a piriformis stretch at final reassessment.

The patient presented with increased hip medial rotation during gait and during single leg stance as the TFL was dominant over the iliopsoas and posterior gluteus medius. During the supine active SLR, the greater trochanter was found to move in an anterior and medial direction when it should maintain in a relatively constant position (an altered PICR). During prone hip extension, the hamstrings were dominant over the gluteus maximus, leading the axis of rotation of the femur to be displaced anteriorly. The anterior pressure exerted by the femoral head combined with decreased posterior glide of the femur during hip flexion lead to impingement on the anterior tissues of the hip joint. These findings lead to the primary interventions of increasing the posterior glide of the femur during hip flexion, enhancing the recruitment of the iliopsoas over the TFL, and reducing the excessive hip extension and medial rotation during functional activities. The main exercise used to improve posterior glide was the quadruped rocking back exercise that used the patient's body weight through the knee to glide the femur posteriorly while they rock backward flexing the hip. No manual techniques were used.

The main goals of the exercises given were to restore the precision of hip motion, improve muscle performance of the iliopsoas, and improve muscle performance of the posterior hip muscles. The patient reported the hip flexor progression had the greatest effect on her pain and ROM. This progression started with supine assisted hip flexion with isometric hold, progressing to sitting assisted hip flexion with isometric hold. These exercises appeared to have been successful based on objective results of improved ROM, strength, and movement patterns.

By the end of week 6, the patient met her main goals of being able to perform a full squat and return to weightlifting. While the patient still had a positive anterior hip impingement test, she no longer displayed a faulty PICR and femoral anterior glide during active SLR. She had improved ROM and strength from the initial evaluation. The patient's change in muscle strength was likely due to improved neuromuscular activation because it takes at least 4 to 6 weeks to achieve strength gains due to muscle hypertrophy.[31]

Unfortunately, outcome measures that evaluate perceptions of disability and limitations of function were not administered during the initial evaluation. In hindsight, a reliable and valid outcome measure such as the Hip Outcome Score could have been used to objectively assess the patient's pain, function, and ROM before and after treatment. The interventions chosen were exercise-based. Exercise-based interventions were chosen to promote independence for the patient from the beginning of her treatment, though it would also be interesting to see what the effect the addition of manual therapy to the exercise intervention would have on a similar patient case. Minimal literature currently exists on using manual therapy techniques to treat FAI but it could potentially help improve hip joint mobility to decrease symptoms.

The patient did not have imaging to confirm the presence of a labral tear, FAI, or other structural hip joint pathology. It is common for patients to be referred to physical therapy without imaging, leaving the physical therapist to design a treatment plan based on the movement impairments found during the evaluation regardless of the presence of a structural defect. While physical therapists cannot change the morphology or shape of the hip joint, they can address movement impairments, muscle strength deficits, and certain aspects of joint ROM to decrease stresses on the anterior hip joint.

Currently, the prevention and treatments of FAI, anterior hip impingement, and labral tears are conflicting at this time. There is limited research regarding appropriate or effective nonsurgical interventions for those with suspected labral tears or FAI.[9,13,22] Ganz et al[21] states that surgical attempts to restore normal anatomy to avoid FAI should be performed in the early stage before major cartilage damage is present, and surgery is the current mainstay of treatment. The outcome of this particular case varies from those reported in the literature as the patient achieved her goals and returned to her prior level of function without surgical intervention. At the end of the treatment program, the patient still presented with a positive anterior hip impingement test; however, no pain was reported with functional activities such as deep squatting and lunging, which meets the patient's goals set at the first visit. The results of this case suggest

Table 3. Microcycle 1 (Week 1-2)

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Rest	Group A	Dance Class	Group B	Rest	Cross-training	Group A

Group A Exercises			
Exercise	**Weight**	**Sets/Reps**	**Rest**
Warm-up: upright bike	Low resistance	5 min	-
Double leg vertical jump	BW	2x4	4 min
Single leg dead lift	BW	3x8	2 min
Single leg heel raises	BW	4x8	2 min
Sidelying hip abduction/lateral rotation	Orange band	3x10	1 min
Level 0.5 abs	-	5x12	<30 sec
Quadruped rocking back	-	2 x 1 min	<30 sec
Supine assisted hip flexion with isometric hold	BW	3 x 1 min	<30 sec
Group B Exercises			
Exercise	**Weight**	**Sets/Reps**	**Rest**
Warm-up: jump rope	-	5 min	-
Double leg hop	BW	2x4	4 min
Sidestepping	Orange band	3x8	2 min
Walking with heel raises	BW	4x10	1 min
4 way hip	BW	3x8	2 min
Side plank	BW	3x30 sec	<30 sec
Quadruped rocking back	-	2 x 1 min	<30 sec
Supine assisted hip flexion with isometric hold	BW	3 x 1 min	<30 sec

Abbreviations: BW, body weight; min, minute; sec, second
Cross training: upright bike or treadmill with incline, 30 minutes
Week 1: long slow distance (target HR 153)
Week 2: interval (target HR 173-178)

that the use of a movement system impairment approach to treat anterior hip pain with signs and symptoms of impingement may be an effective nonsurgical intervention.

There is limited and conflicting evidence regarding conservative treatment of anterior hip pain. Randomized controlled trials are needed to study the effectiveness of the movement system impairment approach in combination with manual therapy techniques to treat anterior hip pain. In addition, clinical trials that compare the functional and subjective outcomes between conservative versus surgical management of anterior hip pain are needed.

CONCLUSION

In this case report, a 27-year-old patient displayed signs and symptoms of FAI for 2 months after performing multidirectional lunges with weight. The patient was evaluated and treated using a movement system impairment approach, which had a positive impact on the patient's pain and function. Exercises given to restore precision of hip motion and improve muscle performance of the iliopsoas and posterior hip muscles appeared to have been successful based on objective results of improved ROM, strength, and movement patterns.

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Table 4. Microcycle 2 (Week 3-4)

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Rest	Group C	Dance Class	Group D	Rest	Cross-training	Group C

Group C Exercises			
Exercise	**Weight**	**Sets/Reps**	**Rest**
Warm-up: upright bike	Low resistance	5 min	-
Squat jump (pain free range)	BW	2x4	4 min
Single leg dead lift	10 lb weight	3x8	2 min
Single leg heel raises off edge of step	BW	3x8	2 min
Cumberford hip series	BW	2xfatigue	2 min
Level 1a abs	-	5x12	<30 sec
Quadruped rocking back	-	2 x 1 min	<30 sec
Supine hip flexion with end range resistance	-	3 x 1 min	<30 sec
Group D Exercises			
Exercise	**Weight**	**Sets/Reps**	**Rest**
Warm-up: jump rope	-	5 min	-
Front barrier hop	BW	2x4	4 min
Sidestepping	Green band	3x8	2 min
Walking with heel raises	5 lb weight in each hand	4x10	1 min
4 way hip	Yellow band	3x8	2 min
Side plank	BW	3x30 sec	<30 sec
Quadruped rocking back	-	2 x 1 min	<30 sec
Supine hip flexion with end range resistance	Self-applied resistance	3 x 1 min	<30 sec

Abbreviations: BW, body weight; min, minute; lb, pound; sec, second
Cross training: upright bike or treadmill with incline, 35 minutes
Week 1: long slow distance (target HR 153)
Week 2: interval (target HR 173-178)

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Table 5. Microcycle 3 (Week 5-6)

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Rest	Group E	Dance Class	Group F	Rest	Cross-training	Group E

Group E Exercises			
Exercise	**Weight**	**Sets/Reps**	**Rest**
Warm-up: upright bike	Low resistance	5 min	-
Split squat jump	BW	2x4	4 min
Single leg dead lift	15 lb weight	3x8	2 min
Cumberford hip series	BW	3x fatigue	2 min
Level 1b abs	-	5x12	<30 sec
Quadruped rocking back	-	3 x 1 min	<30 sec
Sitting assisted hip flexion with isometric hold	BW	5x12	<30 sec
Group F Exercises			
Exercise	**Weight**	**Sets/Reps**	**Rest**
Warm-up: jump rope	-	5 min	-
Double leg tuck jump	BW	2x4	4 min
Sidestepping	Blue band	3x8	2 min
Bird dog with cone on back	BW	4x10	1 min
4 way hip	Orange band	3x8	2 min
Side plank	BW	3x30 sec	<30 sec
Quadruped rocking back	-	3 x 1 min	<30 sec
Sitting assisted hip flexion with isometric hold	BW	5x12	<30 sec

Abbreviations: BW, body weight; min, minute; lb, pound; sec, second.
Cross training: upright bike or treadmill with incline, 35 minutes
Week 1: long slow distance (target HR 153)
Week 2: interval (target HR 173-178)

Note: Tables 6 and 7 can be found on pages 234-235.

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Table 6. Description of Exercises

Exercise	Description
Double leg vertical jump	The patient begins by standing in a comfortable, upright stance with feet shoulder-width apart. The patient then explosively jumps up, using both arms to assist, and reach for a target. The patient should land in the starting position.
Double leg hop	The patient begins by standing in a comfortable, upright stance with feet shoulder-width apart. The patient then hops up, with primary motion at the ankle joint. The patient should land in the starting position.
Squat jump	The patient begins in a squat position (thighs slightly above parallel with the ground) with feet shoulder-width apart. The patient should interlock fingers and place hands behind head, then explosively jump up to a maximum height. The patient should land in the starting position of a squat.
Front barrier hop	The patient begins by standing in a comfortable, upright stance with feet shoulder-width apart. The patient then jumps over a barrier with both legs, using primarily hip and knee flexion to clear the barrier. The knees and feet should be kept together without lateral deviation. The patient should land in the starting position.
Split squat jump	The patient begins in a lunge position with one leg forward (hip and knee joints flexed approximately 90°) and the other behind the midline of the body. The patient then explosively jumps up, using the arms to assist as needed. Maximum height and power should be emphasized. When landing, the patient should maintain the lunge position (same leg forward).
Double leg tuck jump	The patient begins by standing in a comfortable, upright stance with feet shoulder-width apart. The patient then explosively jumps up, pulling the knees to the chest, quickly grasping the knees with both hands, and releasing before landing. The patient should land in the starting position.
Single leg dead lift	The patient begins in standing. If she is holding a dumbbell, she should hold it with both hands. The patient then stands on her leg and leans trunk forward while extending their opposite leg backward. Both the stance leg and extended leg should be straight and the trunk should be kept in neutral alignment, bending from the hip. The patient should attempt to flex her stance hip to approximately 90°, then return to the starting position.
Single leg heel raises	The patient begins by standing on one leg. Keeping the knee straight, the patient then lifts the heel off the ground to maximum height, and then slowly lowers back down to the ground. This exercise can also be done with the heels off the edge of a step for more eccentric contraction.
Sidelying hip abduction with lateral rotation ("clam")	The patient is positioned in sidelying with knees and hips flexed. Keeping the pelvis in neutral or rolled forward, the patient is instructed to keep ankles together and lift knee (hip lateral rotation and abduction). The patient should not attempt to go beyond her available range of motion. The patient should avoid letting the pelvis roll backward to gain more motion.
Sidestepping (with Thera-Band)	The patient begins in a partial squat position with Thera-Band around their knees (easier) or ankles (harder). They then step laterally, keeping trunk erect, feet facing forward, and feet and knees aligned vertically.
Quadruped rocking back	The patient begins on her hands and knees with feet pointing away from body and hips centered over the knees, which are a few inches apart. Position the hips at a 90° angle, spine straight, shoulders centered over hands, and head in line with the body. The patient is then instructed to rock backward toward her heels by moving her hips, then return to starting position.
4 way hip	The patient begins in standing with Thera-Band around one ankle. The other end of the Thera-Band should be anchored to an immovable object. The patient then performs the number of repetitions prescribed in each direction: hip abduction, hip extension, hip adduction, and hip flexion. The moving leg should be kept straight, while the stance leg should have a slight bend in the knee. The patient should always pull the Thera-Band away from its anchor (ie, when performing hip extension, the patient should be facing the anchor point and extending the hip backward, away from the anchor point).
Side plank	The patient begins in sidelying with legs straight, one on top of the other, and propped up on bottom forearm with elbow at 90°. The arm should be directly under the shoulder and the trunk should be in neutral (not rotated forward or backward). The patient then lifts the body off the table, with only the bottom foot and bottom forearm on the table. The patient sustains this position for the instructed amount of time and then returns to the starting position.
Cumberford Hip Series	A 5-part hip strengthening series. The patient completes each step to fatigue before moving on to the next step. By step 5, the patient should be fatigued and able to complete few repetitions. 1. Sidelying hip abduction with lateral rotation (explained above). 2. Sidelying hip medial rotation, with hips and knees in flexion, keeping knees together, and lifting ankle. 3. Same as step 1 but leg is held in the air and not resting against lower leg. 4. Same as step 2 but leg is held in the air and not resting against lower leg. 5. Sidelying hip abduction and extension with knee extended.
Quadruped hip extension with alternate shoulder flexion ("bird dog")	The patient begins on hands and knees with feet pointing away from body and hips centered over the knees, which are a few inches apart. Position the hips at a 90° angle, spine straight, shoulders centered over hands, and head in line with the body. The patient then extends one hip and knee and lifts the alternate arm, keeping spine in neutral alignment. Both the leg and arm that were lifted should be straight and in line with spine. The patient then returns to starting position.
Lower abdominal progression	The patient begins in the supine hooklying position. The patient is cued to contract abdominal muscles by "pulling your navel toward your spine." 0.5: The patient lightly holds one knee to chest and lifts alternate foot. The patient should not allow back to move and should maintain abdominal contraction, then lower foot back to table. 1a: The patient lifts one knee towards chest (flexing hip past 90°) and lifts alternate foot while maintaining abdominal contraction and neutral spine. The patient then lowers alternate foot to table, then lowers other leg. 1b: Same as 1a described above but the hip is flexed to 90°.

(Continued on page 234)

Table 6. Description of Exercises *(Continued from page 233)*

Exercise	Description
Supine assisted hip flexion with isometric hold	The patient begins in the supine hooklying position. Keeping the spine in neutral alignment, the patient uses a towel or belt to lift the knee towards the chest, flexing the hip to end range, while using only upper extremities to lift the leg. The patient then holds the leg in the same exact position while letting go with upper extremities, engaging the iliopsoas. After a 5-second hold, the patient then returns to using the upper extremities only to slowly lower the leg back down to the table.
Supine hip flexion with end range isometric resistance	The patient begins in the supine hooklying position. Keeping the spine in neutral alignment, the patient uses a towel or belt to lift the knee towards the chest, flexing the hip to end range, while using only upper extremities to lift the leg. The patient then holds the leg in the same exact position while letting go with upper extremities, engaging the iliopsoas. The patient applies an isometric force to the knee for a 5-second hold, then returns to using upper extremities only to slowly lower leg back down to the table.
Sitting assisted hip flexion with isometric hold	The patient begins with spine in neutral alignment and feet flat on the floor. Keeping the spine in neutral alignment, the patient uses a towel or belt to lift the knee in the air, flexing the hip to end range, while using only upper extremities to lift the leg. The patient then holds the leg in the same exact position while letting go with upper extremities, engaging the iliopsoas. After a 5-second hold, the patient then returns to using upper extremities only to slowly lower leg back down to sitting.

Table 7. Target Heart Rate Calculations

	Target % HRR	Calculation	Target HR
Interval (1:1 work:rest)	85-90%	((193-60)*.85)+60 ((193-60)*.90)+60	173-178 bpm
Long Slow Distance	70%	((193-60)*.70)+60	153 bpm

Abbreviations: HRR, heart rate reserve; HR, heart rate; bpm, beats per minute
Target heart rate calculations based on the Karvonen equation: [(maximum HR – resting HR) * target % HRR] + resting HR
Estimated maximum HR based on age: 193 bpm
Resting HR: 60 bpm

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Cervicogenic Dizziness Post-concussion: A Case Report

Kristen Saviola, BS, AT[1]
Thomas Coleman, PT, DPT, FAAOMPT[2]
Michael Ross, PT, DSc, OCS[2]
Ron Schenk, PT, PhD, OCS, FAAOMPT[2]

[1]*Athleticare, Catholic Health System, Buffalo, NY*
[2]*Daemen College Fellowship Program in OMPT, Amherst, NY*

ABSTRACT

Study Design: Case report. **Purpose:** The purpose of this report was to describe the outcomes associated with a physical therapy intervention that involved manual physical therapy followed by cervical spine stabilization exercises in a female patient with cervicogenic dizziness and chronic neck pain following multiple concussions. **Background:** While concussions may occur as a result of falls, motor vehicle accidents, and trauma, recent attention to this condition has been directed to those that occur in sport. The greatest frequency of sport-related concussions occur in collision and contact sports such as football, hockey, lacrosse, basketball, and soccer. **Methods:** A 23-year-old former collegiate soccer player was examined and treated in physical therapy 2 years status post-concussion on the recommendation of her physician. The patient was screened and managed for post-concussion syndrome and vestibular involvement by other medical professionals prior to the physical therapy initial examination. The physical therapy examination revealed constant and unchanging cervical pain, inability to visually focus, and dizziness with reading, computer work, and turning of the head. The only clinical test shown to reproduce dizziness was end range cervical rotation. The physical examination was also characterized by cervical spine hypermobility, lower trapezius and lumbopelvic core weakness, median neural tension, scapular trigger points, and an inability to recruit the deep neck flexors. The subject's Focus on Therapeutic Outcomes (FOTO) intake score indicated elevated fear avoidance. The cervical joint position error test indicated errors greater than 6 cm as measured with the cervical range of motion device on all 6 attempts. **Results:** Phase I intervention was 6 weeks in duration and included postural correction, non-thrust manipulation of the mid-cervical spine, and the initiation of deep neck flexor training. The outcomes of Phase 1 included an improved ability to contract the deep neck flexors and a 40-point improvement on the FOTO in Fear Avoidance. The Neck Disability Index (NDI) at the end of Phase 1 indicated moderate disability (36%). Phase 2 intervention was 6 weeks in duration and involved a progressive in-clinic and home cervical spine and lumbopelvic stabilization program. The outcomes related to Phase 2 management included an improvement in the cervical relocation test to an error of less than 4.5 cm for each of the 6 attempts and an improvement in the NDI to 8%. The score on the FOTO tool improved from 53 to 68, representing a clinically meaningful positive change in function. **Conclusion:** Management of cervicogenic dizziness and chronic neck pain in patients following a concussion may include non-thrust and thrust manipulation, soft tissue mobilization, and stabilization exercises for the cervical deep musculature. This case illustrates the potential benefit of facilitating neuromuscular control of the cervical stabilizing muscles to address the cervical hypermobility and dizziness that may occur post-concussion. Further research is warranted to determine the efficacy of this intervention strategy.

Key Words: neck pain, head trauma, stabilization

INTRODUCTION

While concussions may occur as a result of falls, motor vehicle accidents, and trauma, more recent attention to this condition has been directed to those that occur in sport.[1] Dizziness related to the cervical spine, or cervicogenic dizziness, may have etiologies related to the cervical sympathetic nervous system, mechanical compression or stenosis of the vertebral artery, and/or involvement of the proprioceptors of the upper cervical spine.[2,3] The diagnosis of cervicogenic dizziness, particularly when occurring post-concussion, is one of exclusion.[2]

Chronic neck pain is a common orthopaedic complaint, which results in medical expenses and lost wages totaling in the billions of dollars.[4] While medical intervention is being sought for pain relief, proprioceptive deficit is also associated with chronic neck injury.[5] Moreover, neck pain has a direct influence on an individual's ability to gain accurate proprioceptive information relative to position sense and alignment.[3,6]

Many patients seek physical therapy intervention for neck pain. Comprehensive patient evaluation provides prognosis and potential for returning to function. Numerous tests and measures are used to assess neck pain and associated impairments, and one such test is the cervicocephalic relocation test (CRT). The CRT is used to assess position sense and joint integrity of the cervical spine. If cervicogenic dizziness is thought to possibly emanate from involvement of the cervical proprioceptors, assessment should include measuring the subject's ability to return to neutral head position (NHP). The majority of previous research examined the ability to relocate to NHP using an affixed laser pointer,[5] ultrasound,[7] or cervical range of motion device (CROM).[8] Cervical relocation testing using a CROM (Figure 1) is a clinically applicable and inexpensive alternative to more costly and complex CRT equipment and adjunct software. The CROM may be an inexpensive and reliable method for cervical relocation test if intraclass correlation between testers is greater than or equal to 0.75.[8]

The CRT that uses the laser measure[5] (Figure 2) can be used for the clinical evaluation of a person's ability to relocate the head on the trunk back to a neutral position after an active head movement. This test of cervical spine relocation to neutral head position, when executed in its original form, has been proven to have fair to excellent reliability in labryinthine-defective and chronic non-traumatic neck patients.[5] Since concussion often results in a whiplash-type trauma to the cervical spine, testing for cervical relocation may have application to this population. A study using the CRT indicated that subjects with whiplash-associated disorders and dizziness had greater joint position errors than those without dizziness following rotation and a higher neck pain index. Cervical mechanoreceptor dysfunction is hypothesized to be a cause of dizziness in whiplash-associated disorder. Studies have also demonstrated that this ability to relocate the head after an active

head movement was significantly poorer in the patients with cervical pain, indicating an alteration in neck proprioception and a negative impact on function.[5,9,10] A physical therapy treatment approach that focuses on stabilization of the cervical spine may be efficacious for patients who experience neck-related dizziness. The purpose of this case report was to describe the outcomes associated with a physical therapy intervention that involved manual physical therapy followed by a cervical spine stabilization program in a female patient with cervicogenic dizziness and chronic neck pain experienced following multiple concussions. The case report was approved by the Catholic Health System Institutional Review Board.

CASE DESCRIPTION

The patient was a 23-year-old female who had a history of two concussions experienced during gymnastics as an adolescent, followed by a neck injury, and concomitant concussion 4 years ago. The latest neck-related injury occurred while attempting to head a ball while playing collegiate soccer and resulted in an end to her competition that season. One week following the incident, the patient reported dizziness and "popping of the neck" with movement. This was also accompanied by vision changes characterized by difficulty focusing and reading. During the following week she began developing neck pain and decreased range of motion which she attributed to "muscle spasm." Over the next month, worsening of her dizziness, neck pain, decreased range of motion, and balance difficulties ensued. Her primary care physician referred her for an Erythrocyte Sedimentation Rate test, a hearing evaluation, and vestibular testing. The vestibular tests included rotatory chair testing for vestibular function and cerebellar ocular motor abnormalities, fistula testing for the detection of perilymphatic fistula, and electronystagmogram and videonystagmography for vestibular involvement. All of the aforementioned tests were normal. Based on her continuing symptoms, a neurologist diagnosed her with occipital neuralgia, a neurological condition in which the occipital nerves that run from the top of the spinal cord at the base of the neck up through the scalp are inflamed or injured. Following this diagnosis she was referred to physical therapy.

She attended physical therapy for 6 weeks that consisted of 18 visits of general stretching of the upper quarter and strengthening prescribed for the cervical erector spinae and upper and middle trapezius muscles. After 6 weeks, there was minimal improvement according to the subject, which led her to seek chiropractic care. She received chiropractic manipulation of the cervical and thoracic spine for 42 visits over the course of a year, which reportedly increased her cervical mobility, but did not significantly impact her dizziness or visual disturbance. Feeling that her neck was "unstable," she discontinued chiropractic care and was self-referred for further management to a different physical therapist who was fellowship trained in orthopaedic manual physical therapy (OMPT).

Examination

The OMPT examination consisted of a history followed by a structural examination and assessment of active and repeated end range motions, intervertebral motion testing, neurological testing (including neural tension testing), palpation, and an assessment of muscle performance focusing on neuromuscular control and contractility of the deep neck flexor and extensor muscles and the lumbopelvic core muscles. Baseline measures also included the CRT as assessed with both the laser and a CROM. In both assessments, the patient demonstrated significant difficulty in relocating to a neutral position following turning of the head. In the CRT, the patient failed to relocate within 4.5 cm of the target on all 6 attempts (rotation to each side for 3 repetitions) and was greater than 10° of neutral in all 6 attempts as measured with the CROM. In addition, this patient was assessed through the Focus on Therapeutic Outcomes Tool (FOTO), and the Neck Disability Index (NDI). The FOTO is an electronically administered survey that assesses the patient's perceived level of function. The FOTO tool is designed to determine rehabilitation effectiveness and efficiency in outpatient orthopaedic clinical practice.[11] Unlike the NDI,[10] FOTO includes the patient's perceived health status, age, symptom acuity, surgical history, and co-morbid conditions that factor into the person's overall functional status, and functional limitation G codes severity modifiers, to track outcomes.[11] The G code severity modifiers are comprised of 5 categories of ranked perceived disability 20% intervals. In the FOTO, the lower score represents greater disability and a positive change in at least one category represents a potential meaningful change.[11]

The NDI provides a useful, reliable, and valid way of measuring the clinical outcomes of patients with neck pain. The NDI is a 10-item questionnaire based on the Oswestry Low Back Pain Index that assesses disability

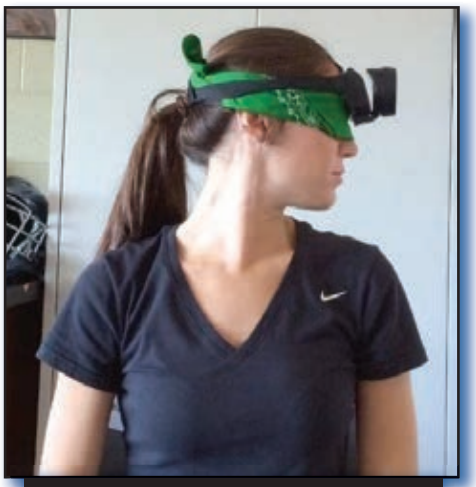

Figure 1. Cervical relocation laser.

Figure 2. Cervical relocation cervical range of motion device.

associated with neck pain and whiplash.[12,13] There are 4 items that relate to subjective symptomatology (pain intensity, headache, concentration, sleeping) and 6 items that relate to activities of daily living (lifting, working, driving, recreation, personal care, reading).[14] Changes in NDI score of 10 points have been found to be clinically meaningful.[15]

Evaluation

In addition to the aforementioned physical examination measures, this patient was further screened clinically by the examining physical therapist through the administration of the Sharp-Purser, Aspinall, Alar ligament, odontoid fracture, rotatory nystagmus, and vertebral artery tests. These clinical tests, although purported to lack sensitivity and specificity, were used to determine if the patient may be a candidate for manual physi-

cal therapy intervention. These tests, including the vertebral artery test were all negative, with reproduction of dizziness only occurring with end range of active cervical rotation as assessed in sitting.

Positive examination findings included excessive active and passive motion, with increased segmental mobility in extension at C4-5 and C5-6 and sidebending right at C5-6. Repeated neck retraction decreased her cervical pain. Minimal weakness was noted at the right C5 myotome (biceps) in bilateral comparison. Median neural tension was noted at 0° to 120° elbow extension on right and 0° to 140° on left. The patient was unable to contract the deep neck flexors in supine without compensation of the sternocleidomastoids and she was unable to maintain the head one inch off the table when asked to contract the deep neck flexors in supine. Myofascial trigger points were noted in the right levator scapulae and left upper trapezius. Although the examination included tests and measures commonly used to assess cervical spine, there is little consensus regarding what should be used in patients post-concussion.[16] The baseline measures of the initial examination are summarized in Table 1. The physical therapy diagnosis was cervical spine hypermobility and cervicogenic dizziness.

Intervention

The intervention for this patient consisted of two subsequent phases. Phase 1 intervention was 8 weeks and 13 visits in duration, which included interventions directed toward the impairments noted in the initial examination: postural correction, joint non-thrust manipulation directed toward hypomobility in sidebending right at C4-5, neuromobilization of the median nerve bilaterally, and the initiation of deep neck flexor training. Although the patient had shown some symptomatic improvement at the end of Phase 1, her complaints of difficulty with dizziness with turning of the head and visual focusing persisted. The clinical decision at this point was to progress the patient to a cervical spine stabilization program.

Phase 2 intervention was 6 weeks and 6 visits in duration and involved a progressive in-clinic and home cervical spine and lumbopelvic stabilization program to address her dizziness complaints. The cervical spine stabilization program focused on in-clinic instruction and a home exercise program focused on a progressive engagement of the deep neck flexor and extensor muscles beginning in supine and progressing to prone, sidelying, standing, and on a therapy ball. Figures 3-7 depict the stabilization program. In addition, the patient was instructed in stabilization exercises for the lumbopelvic region and was asked to maintain a record of her home program.

Cervical Spine Stabilization

The cervical spine stabilization exercise program used in this case involved a progression to the performance of exercises in increasingly challenging stages with monitoring for reproduction of dizziness. If either pain or dizziness was encountered during the exercise, that particular exercise was discontinued. At each stage in the progression, the clinician clearly explained, demonstrated, and then had the patient perform the exercises without pain and without movement of the spine. The first progression of the program was performed in supine and is demonstrated in Figure 3.

With the patient in supine, the clinician used a stabilizer cuff to give the patient feedback as to whether she was moving the cer-

Table 1. Initial Examination Findings

Measures	Findings					
AROM	0-60° flexion	0-100° extension	0-65° sidebending right	0-65° sidebending left	0-95° rotation right-produced dizziness	0-90° rotation left-produced dizziness
Joint mobility		Extension hypermobility C4-5, C5-6	Right sidebending hypomobility C4-5 hypermobility C5-6			
CRT laser CRT CROM					>4.5 cm error >10° error	
Repeated retraction		Decreased neck pain				
Neurological		Hyperreflexia throughout	Weakness right C5 myotome			
Neural tension			Right median neural tension 120°	Left median neural tension 140°		
Muscle performance		Unable to maintain contraction of DNF < 5s				
Palpation			TP right levator scapulae	TP left upper trapezius		
FOTO NDI	53 36					

Abbreviations: AROM, active range of motion; CRT, cervical relocation test; CROM, cervical range of motion device; TP, trigger point; DNF, deep neck flexor; s, seconds; FOTO, Focus on Therapeutic Outcomes score; NDI, Neck Disability Index score

Figure 3. Supine deep neck flexor training.

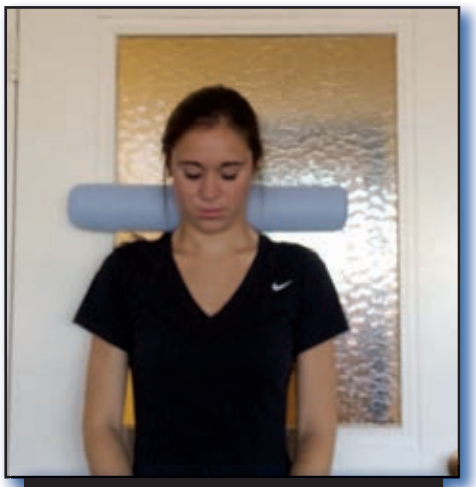

Figure 6. Standing deep neck flexor training.

Figure 4. Prone deep neck flexor training.

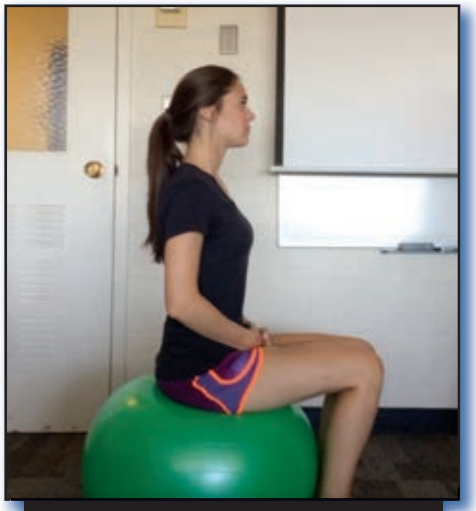

Figure 7. Deep neck flexor training on therapy ball.

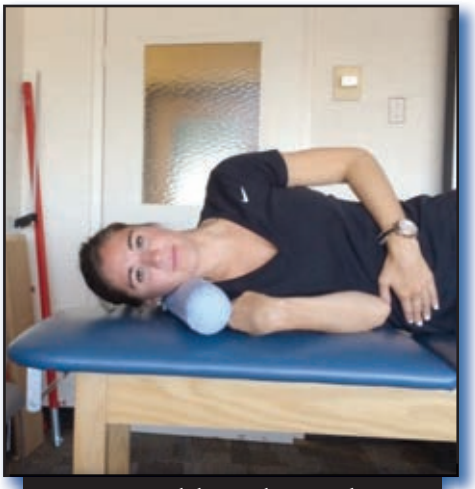

Figure 5. Sidelying deep neck flexor training.

vical spine. In addition to keeping the spine stable, the clinician explained the importance of not using the long neck flexors, particularly the sternocleidomastoids (SCMs). The clinician also had the patient palpate the SCMs and lift the head off the table so that she could appreciate that these muscles should not be used. The clinician further explained that the core muscles are those deep neck flexors that lie between the SCMs and closer to the bodies of the vertebrate. The patient began with a 5-second hold of 3 sets of 10 repetitions with the stabilizer cuff inflated to 20 mm of mercury. The progression in supine went from 20 to 22 to 24 to 26 to 28 mm of mercury and/or from a 5- to 7- to 10-second hold and took 2 sessions to perform correctly without symptoms. The patient was instructed to perform 3 sets of 10 repetitions of this exercise at home 3 times daily with a cervical roll being substituted for the stabilizer cuff.

During Phase 2 sessions 3 and 4, the patient progressed to stabilization exercises performed in prone (Figure 4). In this exercise, it was emphasized to the patient that the axis of motion was through the ear. In this position, the motion in this position was gravity assisted for flexion, but required contraction of the deep neck extensors to return to neutral. The patient began to perform the exercise incorrectly, and because pain was reproduced, it was stopped. It was then conveyed to the patient that she not extend the neck because that muscle action involves a contraction of the erector spinae. With proper performance, the patient was able to perform the exercise without pain and was instructed to perform the maneuver for 3 sets of 10 repetitions at home 3 times daily in addition to the supine exercises.

Sessions 5 and 6 included instruction in exercises in sidelying, standing, and on a therapy ball. While in sidelying (Figure 5), the patient again palpated the SCMs and the clinician observed the patient to make sure that the patient only sidebent the upper cervical spine. The axis for this motion was through the nose. The patient also learned to palpate posteriorly so she could appreciate the co-contraction of the deep neck extensors, which include the rectus capitis posterior major and minor, and the semispinalis capitis.

The standing stabilization exercise (Figure 6) was actually gravity assisted but was considered more functional because the patient was performing the exercise in weight bearing. Again, the axis of motion was through the ear and the contraction of the SCMs was avoided. The first challenge on the therapy ball (Figure 7) was maintaining the correct sitting posture, thereby facilitating a co-contraction of the deep neck flexors and extensors. Once the patient was able to maintain a correct sitting posture and maintain sitting balance, a contraction of the deep neck flexors was to be performed. The sidelying, standing, and therapy ball exercises were performed for 3 sets of 10 repetitions in the clinic. The home program following these sessions included 3 sets of 10 repetitions supine, sidelying, and standing. A further progression may involve the use of weights in the hands and movements in diagonal or proprioceptive neuromuscular facilitation patterns. Other weight bearing functional exercises and progressive resistive exercises may follow, which would be considered the third phase of the program.

RESULTS

The outcomes of Phase 1 intervention included an improved ability to contract the deep neck flexors and a 40-point improvement in the FOTO in fear avoidance. The NDI at the end of Phase I indicated moderate disability (36%). The outcomes related to Phase 2 management included an improvement in the cervical relocation test to an error of less than 4.5° for each of the 6 attempts, an improvement in the NDI from 36% to 8%, and an improvement in function on the FOTO tool from 52 to 68. This was greater than one category of change, which is considered clinically meaningful. The patient did not return to sport, but returned to fitness activity that included ambulation on a treadmill and exercising on an elliptical for 20 minutes at moderate intensity on alternate days. Improvements were noted in complaints of dizziness (which were abolished and not reproduced with neck rotation), cervical relocation, extension hypermobility, neural tension on left, muscle performance of the deep neck flexors, FOTO, and NDI. The outcomes and discharge findings following Phase 2 are found in Table 2.

DISCUSSION

Malstrom et al[16] found dorsal neck and zygapophyseal joint tenderness and excessive CROM to be characteristic of cervicogenic dizziness. These characteristic findings of cervicogenic dizziness were also present in the patient examined and treated in this study. Another finding in this case was reduced contractility of the deep neck flexor muscles, impairment consistent with a study by Falla, Jull, and Hodges[17] who found reduced performance in the craniocervical flexion test in patients with chronic neck pain. Treatment of cervicogenic dizziness may involve strengthening of the cervical spine musculature, soft tissue mobilization, and non-thrust and thrust manipulation. Manual therapy treatment of cervicogenic dizziness was found to have Level 3 evidence in a systematic review.[18] Reid et al,[19] following an earlier protocol,[20] compared the effectiveness of sustained natural apophyseal glides and Maitland mobilizations for cervicogenic dizziness with both manual therapy groups demonstrating reduced dizziness intensity and frequency posttreatment and at 12 weeks. This was further supported in a randomized controlled trial[21] and has been shown to impact long-term outcomes.[22] These findings may explain why the subject in this study demonstrated an improvement in function and a reduction of dizziness in Phase 1 of the program, which consisted of non-thrust manipulation and neuromobilization. In terms of reduction of dizziness, Phase 2, which focused on stabilization, may have been more related to a change in this patient's outcome. Although stabilization is often confused with strengthening, research on strengthening the cervical musculature has been shown to produce favorable results in female patients who have similar chronicity. In a study of 46 patients with chronic neck pain, Jull et al[22] found low load craniocervical flexion increased deep neck flexor EMG amplitude. Chronic neck pain and cervicogenic headache are conditions which Jull et al[22] have found to be responsive to a cervical spine stabilization program as well. Jull et al[9] found poor endurance of the deep neck flexors as a consistent finding in patients presenting with cervicogenic headache. In a study of the effectiveness of various combinations of an cervical exercises, Jull et al[23] found that scapular retraction exercises, low-load cervical flexion and extension resistive exercises, postural education, and deep neck flexor endurance training reduced headache frequency and intensity in 200 patients diagnosed with cervicogenic headache. The patient in this case study had headaches that appeared to be responsive to training for endurance of the deep neck flexors.

In this case study, a female patient with cervicogenic dizziness and chronic neck pain was treated with a progressive cervical spine stabilization program. In another study examining women with chronic neck pain, Ylinen et al[24] found that active neck muscle training focusing on both strength and endurance improved neck pain and reduced disability. Although the findings were not attributed to a patient following concussion, Thoomes-De Graaf and Schmitt[13] found a deep neck flexor training program similar to that used in this case to demonstrate reduced dizziness and an increase in cervical range of motion in a 19-year-old female experiencing cervicogenic dizziness.

The program used in this study was simi-

Table 2. Outcomes Following Phase 2

Measures	Findings					
AROM	0-50° flexion	0-90° extension	0-65° sidebending right	0-65° sidebending left	0-90° rotation right-no dizziness	0-90° rotation left-no dizziness
CRT laser CRT CROM					<4.5 cm error <10° error	
Joint mobility		Extension hypermobility C5-6	Right sidebending hypermobility C5-6			
Neural tension			Right median neural tension 120°	Left median neural tension 120°		
Muscle performance		Maintained contraction of DNF > 5 s				
FOTO Score NDI	68 8%					

Abbreviations: AROM, active range of motion; CRT, cervical relocation test; CROM, cervical range of motion device; DNF, deep neck flexor; s, seconds; FOTO, Focus on Therapeutic Outcomes score; NDI, Neck Disability Index score

lar to that in a study by Schenk et al[2] who found that a treatment progression based on a progressive cervical spine stabilization program improved pain and improved function in a female patient with chronic neck pain. In both this and the previous case report, the physical therapy sessions required considerable cueing for proper performance as well as monitoring for either reproduction of pain or dizziness. Unlike traditional strengthening programs that may be performed outside of the clinic setting, the attainment of painfree neuromuscular control requires consistent and continuous feedback, verbal cueing, and assessment of patient response.

LIMITATIONS

The outcomes described in this study are applicable only to this case but point toward the potential benefit of stabilization exercises for cervicogenic dizziness post-concussion. Further research on larger samples and in a randomized controlled design is warranted to determine the efficacy of this intervention strategy.

CONCLUSION

Management of cervicogenic dizziness and chronic neck pain in patients following a concussion may include non-thrust and thrust manipulation, soft tissue mobilization, and strengthening exercises for the cervical musculature. Although strengthening involves dynamic muscular contraction through a range of motion, this case illustrates the performance of exercises performed from a controlled position through a specific range of motion in a painfree manner. It may point to the potential benefit of facilitating neuromuscular control of the cervical stabilizing musculature to address cervical hypermobility and dizziness that can occur post-concussion.

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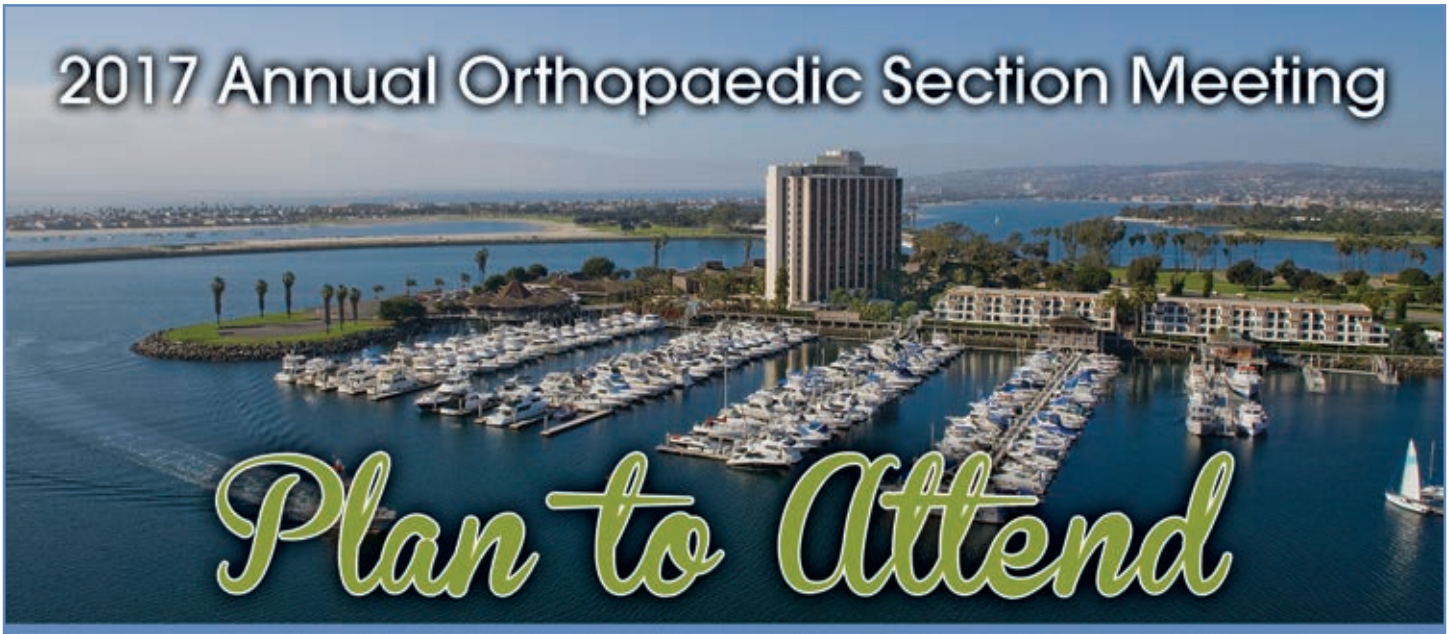

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Schroth Therapy for Scoliosis in a Patient with Familial Dysautonomia: A Case Study

Harleen Bawa, PT, DPT

Rehab Core Physical Therapy, Mineola, NY

ABSTRACT

Purpose: This case presents a successful physical therapy intervention for the treatment of scoliosis and other neuromuscular disorders in familial dysautonomia (FD) for a patient. **Case Description:** The patient is a 10-year-old girl with FD whose juvenile scoliosis started developing around the age of 7. She presents with a main right thoracic curve and small compensatory curves at the cervical and lumbar areas. She also presents with general muscle weakness, impaired gait, and slight balance deficits. The patient treatment plan consists of conventional physical therapy in combination with Schroth therapy for scoliosis and a Providence nighttime brace. **Outcome:** The patient's Cobb angle reduced by 6° in 3 months and has stabilized since then. Her posture has improved and she is able to perform sports activities involving greater endurance and balancing skills. There has been an overall improvement in the patient's quality of life.

Key Words: Cobb angle, juvenile scoliosis, physiotherapeutic scoliosis specific exercises, Riley-Day syndrome

INTRODUCTION

Familial dysautonomia (FD), also known as Riley-Day syndrome, is a rare genetic disorder of the autonomic nervous system that primarily affects Ashkenazi Jewish people of Eastern European heritage.[1,2] The disorder is characterized by widespread sensory dysfunction and variable autonomic dysfunction caused by incomplete development of sensory and autonomic neurons. Neuromuscular involvement is seen with hypotonia and spinal scoliosis.

Children with FD present with developmental delays, low muscle tone, an inability to respond to pain and temperature, recurrent pneumonia, hypotension, and ataxia. Atonomic "crisis" is common due to stress triggered by infection or emotional distress. Deep tendon reflexes are often absent due to hypotonia. Impaired renal function, cardiovascular instability, and progressive scoliosis (spinal curvature) are common co-morbidities.[1-5] Scoliosis is found before the age of 13 years in 90% of children with FD.[3]

Schroth therapy is a 3-dimensional approach developed by Katharina Schroth in 1921 in Germany. Its principles are based on corrections in sagittal, frontal, and transverse planes.[6] Schroth therapy uses therapeutic exercises to improve scoliotic posture through elongation and realignment of trunk segments, positioning of arms, and use of a specific breathing pattern (rotational angular breathing).[6,7]

CLINICAL MANAGEMENT

Clinical management of FD involves a multidisciplinary approach including care by a physical therapist, occupational therapist, speech therapist, neurologist, endocrinologist, pulmonologist, cardiologist, orthotist, psychiatrist, and development specialist. Discussion of each discipline and management of all possible co-morbidities is beyond the scope of this article, which is focused on the treatment of scoliosis. Physical therapy management includes physiotherapeutic scoliosis specific exercises (PSSE), such as Schroth therapy for scoliosis, and conventional physical therapy interventions for improving strength, endurance, posture, and balance.[6,7] Bracing is effective in reducing and/or delaying further progression of the scoliosis,[4] but must be managed carefully for rashes and skin pressure ulcers due to lessened pain sensation.[8]

EPIDEMOLOGY AND ETIOLOGY

Familial dysautonomia is caused by a genetic point mutation in the l-k-B kinase complex associated protein it encodes, IKAP(2-4).[1] Familial dysautonomia is found almost exclusively in people of Ashkenazi Jewish descent, where it affects approximately 1 in 3,700 people. Hayek et al[9] found that the prevalence of spinal deformity in patients with FD who had lived for at least 20 years was 83%. By the age of 10 years, 52% of patients have scoliosis and 21% have kyphosis with or without scoliosis.

CASE DESCRIPTION

Gina (pseudonym) is a 10-year-old Jewish girl in premenarchal age who presents with mild to moderate symptoms of FD. She has normal intelligence but delayed physical and emotional development. She was born as a dizygous twin and diagnosed with FD at the age of 3 weeks. Her twin and younger twin brothers are genetic carriers of FD. Gina has been getting physical and occupational therapy at home and school since she was 6 weeks old to develop her motor skills. At age 7, she was diagnosed with scoliosis and her curve progression was monitored regularly by her physician and the school-based physical therapist. By age 10, the curve had progressed to 35° (Figure 1) and she was recommended for Schroth therapy for scoliosis with a night brace in addition to rehabilitation services received in the school setting. School services were provided 3 times a week for a total of 90 minutes.

Schroth therapy is a 3-dimensional based exercise program to correct scoliosis. It uses breathing mechanics, muscle activation, and mobilization. Schroth principles of correction[6] are based on self-elongation from a neutral pelvis, de-rotation of shoulder, pelvis and rib cage towards neutral, rotational angle breathing to open retracted areas, and stabilization to strengthen balance position. Practitioners using the Schroth method can be certified in the technique after completing a formal education program, although a manual on the technique is available online (Schroth website http://www.schroth-method.com). The author (HB) is certified in the Schroth method and initiated Schroth therapy for the patient.

CLINICAL EXAMINATION

Gina attends school full-time and is independent in activities of daily living (ADLs). She has a normal IQ and enjoys arts and crafts, but she was unable to participate in any sport activities due to insufficient endurance for community ambulation and outdoor recreation.

She is on the prescription medication Zantac, and she gets nebulization every day with Pulmicort (0.5 mg) and hypertonic saline. She wears an airway clearance vest for 20 minutes daily. She is also taking various supplements including Tocotrienols, green

tea extract, olive leaf extract, folic acid, omega 3, calcium, vitamin D3, beta carotene, and dry A vitamin supplement.

On initial examination, Gina showed scoliotic posture with the major curve, a right thoracic curve with a right rib hump (Figure 2). Her sagittal postural deviations included cervical hyperlordosis, thoracic hyperkyphosis, and lumbar hyperlordosis.[11] Changes in the frontal plane were a side shift of her thoracic spine to the right and tilting of her neck to the left. Transverse plane changes included right protracted shoulder, left retracted shoulder, and right thoracic rib hump, with neck rotated to right. She had tightness of the hamstring muscles in both legs, a diminished sensation to pain and temperature and impaired gait pattern presenting initial contact on toe in the stance phase in both legs. She also had balance deficits during quick turns and transfers.

Tests and Measures

On direct palpation, Gina had mild to moderate tenderness over her right trapezius and right rhomboids. She did not have any measureable joint limitation in range of motion in her upper and lower extremities. Mild spinal limitation was noted in right side bending and left rotation of her thoracic spine. Gross muscle testing was performed and the patient had a grade of fair for strength in both upper and lower extremities.

Special tests

The Adam's forward bend[10] test was positive for scoliosis with rib hump on the right convexity at thoracic level. Her angle trunk rotation was measured by a scoliometer[11] as 6° to 7° at the T8 level. Her Pediatric Balance Test score was 32/56. The Six-minute Walk Test[12] for endurance was 285 m. The 50th percentile for healthy 10-year-old girls is approximately 625 m.[13] The most recent patient x-ray completed at the time of initial evaluation showed a thoracic Cobb angle[10,11] of 35°. Table 1 shows further information on all the tests that were performed.

DIAGNOSIS AND PROGNOSIS

Based on information from her subjective history and physical examination, the physical therapist determined that Gina has multiple problems that could benefit from PSSE and conventional physical therapy intervention. Her posture, muscle performance, endurance, and gait pattern limitations should all improve with physical therapy.[7]

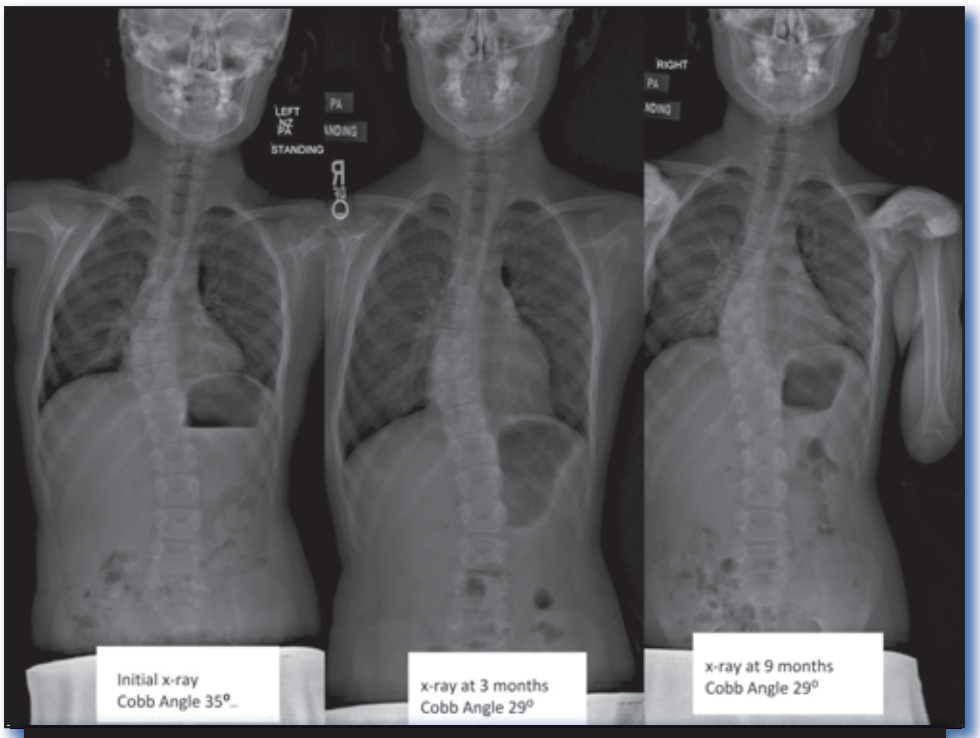

Figure 1. X-rays showing improvement/stabilization of Cobb Angle over the 9-month period.

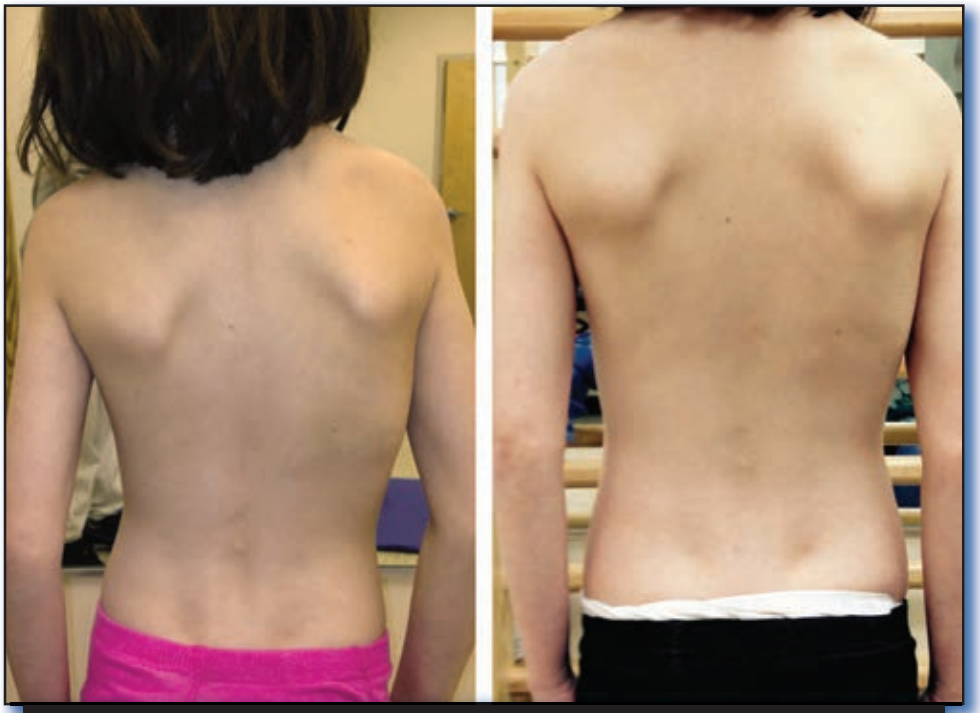

Figure 2. Image of back. A, initial visit. B, after 9 months.

GOALS

The main goal for outpatient therapy was to control the progression of the scoliotic curve and improve self-image.[10] Gina's parents desired to learn a home exercise program (HEP) and were willing to help their daughter continue with exercises at home. Other goals were to improve her endurance in community ambulation and increase sports participation. The school-based physical therapy had similar (comparable) goals, with the outcome focused on Gina's ability to participate fully in her educational setting.

Table 1. Treatment Intervention

Months/Treatment	Outpatient	School	Home Exercise Program
0-2	- Physical therapy evaluation - Schroth exercises for scoliosis - Active self-correction - Neck stretching and isometric exercises - Manual therapy: trigger point therapy over traps and rhomboids - Gait training (normal heel toe gait) - Family education	- Endurance training for upper extremity and lower extremity - Posture in sitting and standing as per Schroth therapy (positioning at school desk) - Gait training(heel toe)	- Activities of daily living and task oriented, positioning (lying, sitting and conscious posture-self correction as per Schroth therapy) - Neck and hamstring stretches - Schroth exercises - Ergonomic care
2-4	- Continued above program - Balance exercises: static and dynamic exercises - Gait training (walking in different directions)	- Strength training exercises with eraBand upper extremity and 2 to 3 lbs for lower extremity - Balance exercises followed in school, one leg standing, open and close eyes activities - Gait training followed	- Continued above exercises - Strength training - Bracing care - Some community ambulation in park to improve endurance and gait pattern
4-6	- Continued above program - Advance dynamic balance exercises	- Endurance training-hopping, squatting, step up and down - Balance training on air disc, tandem walking - Gait training-taking turns, upslope	- Continued above exercises - Community ambulation with less fatigue than before
6-8	- Schroth exercises - Plank exercises for core strengthening - Progression with strength training	- Core/plank exercises - Endurance exercises-jump rope, crab and bear walking added - Gait training - Strength training using weights - Balance training-dynamic (catching and throwing ball, stepper, obstacle course)	- Continued Schroth exercises - High-endurance activities, ie, jogging, playing with a ball with siblings - Recreational activities (monkey bars, rope climbing)
8-10	- Schroth exercises and others continued for maintenance	- High-level strength and endurance program continued	- Continued Schroth therapy - Walked a mile - Participation in playing with siblings - Plays in park on bars and other equipment - Bicycling, ice skating with close supervision/guarding as patient still has some balance deficits

INTERVENTION

Based upon the initial evaluation, a plan of care was developed for Gina that included Schroth therapy, modification of the school physical therapy program to include the Schroth philosophy, and a HEP (see Table 1). Procedural interventions included strength, balance, and gait training to improve general conditioning and endurance. Gina was advised to attend outpatient physical therapy twice a week for an hour, along with a daily HEP. An intervention program was provided with an explanation of technique, and verbal consent was obtained from her parents.

Soft tissue mobilization was performed to improve flexibility, while isometric neck exercises and stretches were performed to improve neck posture. The patient and her parents were instructed in the proper ergonomic care for positioning and lifting in the home. The patient was given lower extremity strengthening exercises that included squats, lunges (forward and side lunges), and wall push-ups for home and school.[14] Gait training was also performed to improve her heel-to-toe gait pattern. Over the course of treatment, the therapeutic exercise program progressed in intensity and type. Specific exercises were varied to maintain her interest. All exercises were administered under the supervision of her physical therapist and parents. Appropriate levels of verbal and manual cueing were given to maintain her spine in a neutral position. Initially, the patient was given more frequent rest periods. Gina had skin blotching and muscle soreness but over time, with better endurance, these decreased.

The school physical therapy program was modified through a verbal conference between the two therapists. The school therapist agreed to focus on an exercise program to improve strength in the proximal trunk/hip muscles (core) with exercises such as planks, squats, lunges, and modified push-ups. Static and dynamic balance exercises include heel/toe walking, single leg stance on various surfaces, heel/toe raises on a flat surface, and 4" and 6" steps. Additionally, stepping up and stepping down, hopping, jumping rope, turning, throwing, and catching a ball are performed. All exercises were progressive to improve agility and balance.[14]

Gina's comprehensive HEP consisted of 30- to 40-minute sessions 5 times a week, divided into 2 components. The exercises consist of Schroth therapy and strength and endurance exercises. The parents are involved in the exercise program and maintain a log of all exercises performed. The family and patient are also educated about postural and

ergonomic care to perform ADLs. Schroth-based ADL exercises are also included to help maintain good posture while performing ADL.[15]

Gina showed considerable improvement after 3 months of therapy. Her Cobb angle decreased from 35° to 29° while her core strength increased. Figure 1 shows Gina's x-rays over the 9-month period. Table 2 shows the improvement after 3 months. After 4 months of Schroth therapy, Gina started wearing a night-time Providence brace (Eschen Prosthetics and Orthotics New York City, NY). The Providence brace applies controlled, direct, lateral, and rotational forces on the trunk to move the spine either toward or beyond the midline. The polypropylene plastic brace is fabricated using computer-aided design (CAD) and computer-aided manufacturing (CAM).[16] Her family was educated about the use and risk of bracing and the importance of discipline and adherence to wearing the brace. They were also advised to monitor for any skin redness and lesions.

RESULTS

Gina showed improvement in all areas with therapy. After a few weeks of treatment, there were changes in her overall posture. Her neck posture improved within two months of initiation of Schroth therapy. She does not have any tilting in her neck. She has mild tenderness in her trapezoids and rhomboids, and she still has hyperlordosis in the lumbar area. Figure 2 shows the picture of patient's back at initial visit and after 9 months. Table 2 shows the patient's progress over a 9-month period of outpatient treatment.

One year after the initiation of Schroth therapy, Gina continues to be seen in outpatient treatment one to two times per week. Her mother states that Gina has been more active in outdoor activities, has improved endurance, and does not get fatigued like before. They agree that her quality of life has improved. Her performance and participation are better in both school and recreational activities. Recently she has also started to ride a two-wheeled bicycle. She plays in the park, climbing the monkey bars, and rope climbing nets. She has better balance for ice skating, and she recently participated in a parade in which she walked for a mile. She can run faster with fewer episodes of losing balance while making turns or hopping over an object. She is continuing to progress with her posture and her physical performance.

DISCUSSION

Hayek et al[9] found that a majority of FD patients develop scoliosis or kyphosis by the age of 10, with a progressive scoliotic curve. Most patients are not able to tolerate bracing due to breathing problems and abdominal difficulties, compliance, and skin pressure ulcers from the brace.[8] Patients with FD have a low body mass index due to gastrointestinal issues, diminished weight bearing, high bone turnover, and changes in bone profusion, which lead to osteopenia. Surgical procedures, including both posterior spinal fusions with instrumentation and anterior fusions, report a high level of actual and potential problems, including a loss of correction.[8] These problems in the FD population have resulted in conservative treatment trials rather than early surgical interventions as seen in idiopathic scoliosis.

As per SOSORT (Society of Scoliosis Orthopedic and Rehabilitation Treatment) guidelines, PSSE are based on the auto-correction of the spine in 3D, training in ADL, stabilizing the corrected posture, and patient education.[6] One study has shown that active self-correction and task-orientated exercises are superior to traditional exercises in reducing spinal deformities and improving the health-related quality of life in patients with scoliosis.[15] Furthermore, these exercises need to be individualized as per patient's needs, curve pattern, and treatment phase. As recommended by the Scoliosis Research Society, PSSE is commonly prescribed in conjunction with brace treatment or for small curves. Unlike physical therapy, PSSE is less often prescribed for the treatment of pain (only 3%). Instead PSSE is commonly prescribed to improve aesthetics (62%), to prevent curve progression (60%), and to improve the quality of life (53%). Further, the most common specific PSSE used was Schroth (57%), followed by Side Shift (22%), Scientific Exercise Approach to Scoliosis (21%), and Functional Individual Therapy for Scoliosis (19%).[7] Due to a lack of high-level evidence for the effectiveness of PSSE, a majority of doctors still do not prescribe it.

There is a need for further research on conservative treatment for scoliosis patients as well as FD patients with scoliosis. However, a few studies show the effectiveness of Schroth therapy for scoliosis. A randomized controlled trial study by Kuru et al[17] showed the effectiveness of Schroth treatment in 51 patients with idiopathic scoliosis compared to the control group. The SOSORT guide-

Table 2. Patient's Progress over 9 Months

Test/Time in months	0	3	6	9
Height (in)	48.75	49.25	50	50.5
Weight (lbs)	50	50.5	53	55
X-rays (Cobb Angle degree) Thoracic	35	29	-	29
Angle Trunk Rotation (degree -T8 level) Using Scoliometer	7	5	5	4
MMT Grades (bilateral upper extremity- shoulder, elbow and wrist)	3/5	3+/5	4-/5	4/5
MMT Grade (bilateral lower extremity – hip and knee)	3+/5	4-/5	4/5	4/5
MMT Grade (bilateral lower extremity – ankle)	3/5	3+/5	4-/5	4/5
MMT Grade – abdominals	3-/5	3/5	3+/5	3+/5
Chest Expansion (nipple level)	60 cm	61.5 cm	62 cm	63.5 cm
Pediatric Balance Scale (maximum score-56)	32	35	39	43
Six-minute Walk Test	285 m	305 m	345 m	390 m
Abbreviation: MMT, manual muscle test				

lines offer an actual standard of conservative care, including braces, exercises, sports activities, and assessment. As per the 2011 SOSORT guidelines, 10-year-old patients can start PSSE.[10]

Hayek et al[9] showed limited effectiveness of bracing in patients with FD. As the curve in FD patients is highly progressive, the treatment plan was designed to stop the progression of the curve using a combination of various known conservative treatments. The patient was initially started with Schroth therapy and strength training. A HEP was designed to make sure she was consistent with her exercise routine. Soon, the school therapy program was modified to complement her outpatient treatment. This combination helped to decrease the Cobb angle by 6° in 3 months. She started wearing the night-time brace after 4 months, and still continues the therapy to keep the curve from progressing. The combination of therapy and night-time brace also helps to maintain good posture and may prevent surgery. This case study is unique, as it shows the effectiveness of a combination of conservative treatments and PSSE for scoliosis to improve neuromuscular and orthopaedic problems in FD patients.

CONCLUSION

This case presents a successful intervention for the treatment of scoliosis and other neuromuscular disorders in an FD patient using conventional physical therapy and Schroth therapy for scoliosis. The patient's Cobb angle decreased from 35° to 29° after 3 months and has been stable since then. Schroth therapy and bracing helped to halt the progression of the curve.[4] Strengthening, balance, and endurance exercises helped to improve the overall physical condition of this FD patient.[10] As the majority of patients with FD will get scoliosis, screening for scoliosis should start early. This will help control the curve in the early stages, using conservative treatment.

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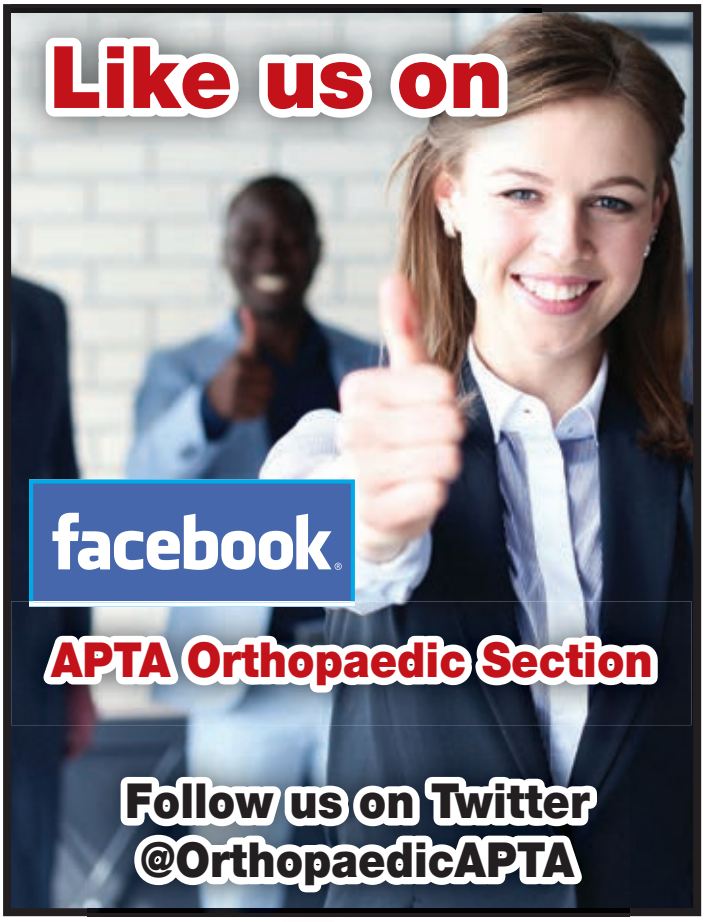

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Application of Regional Interdependence in Treating an Adolescent Athlete with Low Back Pain: A Case Report

Ari Kaplan, PT, DPT, SCS, CSCS, CertMDT

Association of Clinical Excellence, Wilmington, DE
ATI Physical Therapy, Bear, DE

ABSTRACT

Background: Descriptions of treatment of adolescent athletes with non-specific low back pain is sparsely cited in the literature. However, physical therapy is often recommended. **Case Description:** The patient was an 18-year-old high school athlete with low back pain. Interventions consisted of direct treatment (local) at the lumbar spine, and also a focus on improving anterior and rotational hip mobility (global approach). **Outcomes:** The patient was treated for a total of 7 visits with an Oswestry Disability Index improvement from 16% to 0%. **Discussion:** This case report describes the clinical reasoning and interventions of a regional interdependence approach in an athlete where hip deficits were found and were believed to be resulting in altered lumbar mechanics. The resolution of symptoms and full return to activity in a limited number of treatments may suggest the hip to be a contributor of symptom provocation in teenage athletes.

Key Words: physical therapy, lumbar pain

INTRODUCTION

Low back pain is the cause for seeking treatment in nearly 50% of all patients presenting to outpatient physical therapy.[1,2] This does not preclude adolescents, who show a prevalence that is exceedingly high. Estimates cite an effect as great as 70% to 80% of this population by age 20.[3] Recently, clinical prediction rules and treatment-based classifications have been developed to improve the care of patients with back pain.[4-8] They aim to treat a patient through symptom presentation as opposed to focusing on the anatomical diagnosis. While classifying patients has shown improvements in low back pain care,[9] Stanton et al[8] have shown that 50% of individuals will not clearly fit into a classification and half of that 50% (25%) will not fit into any category, resulting in difficulty deciding on the proper treatment. Additionally, past studies have excluded patients under the age of 18 and have not examined athletes as a specific population. The treatment categories also only focus on a specific intervention delivered to the lumbar spine: manipulation, directional preference exercises, stabilization exercises, and traction.[6]

There is a dearth of literature on back pain in the adolescent athlete, with much of this limited focus solely on spondylogenic lesions. Spondylogenic lesions can be illusive in their detection as special testing shows sensitivity and specificity that is poor and therefore often requires advanced imaging, such as magnetic resonance imaging.[10,11] As insurance companies deny greater proportions of advanced imaging, immediately searching for these issues may no longer be an option. Additionally, Fredrickson et al[12] found that 6% of adults showed a spondylogenic lesion, without associated pain in the past. This may be that some of these lesions may not be the source of an athlete's pain.

Clinicians have recently been considering applying the concept of regional interdependence, where one area of the body influences another area.[13] For example, much research has examined the hip's influence on the patellofemoral joint in anterior knee pain, noting that poorly controlled gluteal muscles correlate with patellofemoral pain.[14] Research is beginning to emerge on the effects of treating multiple areas of the body for a diagnosis of lumbar spinal stenosis and showing it to be superior to conventional treatments directed solely at the lumbar spine.[15-17]

In golf, there is research supporting the influence of other regions of the body on lumbar spine injury. Kim et al[18] found that a loss of hip rotation in the lead limb correlates with low back pain in professional golfers. They stated that the kinetic energy normally dissipated during the follow-through was transferred from the lead hip to the lumbar spine, resulting in compensatory excess rotational motion and stress.

Baseball shows high injury rates with most research having looked at the pitcher's shoulder and elbow during healthy and abnormal throwing.[19,20] Fleisig et al[19] have documented the increase in force on the shoulder and elbow with disruptions to the kinetic chain. Recently Shimamura et al[21] examined lumbopelvic motor control in collegiate baseball players. Fifty-two perfect of right-handers and 50% of left-handers were found to have discrepancies between their ability to control active hip rotation through their full available passive range of motion, despite no strength deficits in the gluteus medius and maximus muscles. The study did not link the lack of control to pain or injury. We are unaware of any published research that has investigated the effect of poor kinetic chain movements leading to back pain in adolescent pitchers.

To our knowledge, no literature has applied regional interdependence to treat a teenage positional player in baseball, other than the pitcher's shoulder. The purpose of this case report was to describe the examination procedures and treatment decision making progression for an adolescent baseball player with low back pain who plays both the outfield and pitches.

CASE DESCRIPTION

History

The patient was an 18-year-old right-handed male who played high school hockey and baseball who was referred to physical therapy by a sports medicine physician with a diagnosis of low back pain and a spondylogenic lesion not ruled out. He was experiencing the pain for the prior month with an insidious onset. He denied past trauma to the hips and back.

The patient's past medical history was unremarkable and he noted no previous episodes of low back pain. His symptoms were primarily in the middle of his low back, but at times it could travel into either the right or left side and into the lower thoracic spine as well. He rated this pain at rest at a 1/10, but it could increase to a 6/10 with prolonged sitting. His pain increased to a 6/10 when he lifted weights, played ice hockey, or when playing baseball. The pain was typically sharp in nature when lifting weights or playing

baseball, but dull with prolonged sitting in class. He denied any numbness, burning, or tingling through to lower extremities.

Examination and Evaluation

The patient completed an Oswestry Disability Index (ODI) prior to physical examination. The ODI is a low back functional outcome survey, scored from 0 to 100 with lower scores representing lower disability levels. It has shown both good reliability and validity.[22,23] The minimally clinically important difference (MCID) is 6%.[24] The patient's score on the ODI was 16%.

The patient was evaluated by the author, who considered a local and global approach in identifying multiple contributions of symptoms. His postural assessment revealed an excessive lordosis, most notably at the lumbosacral junction. His active range of motion revealed minimal limitations in flexion and side bending bilaterally, but a 75% limitation in lumbar extension compared to normal with 6/10 pain throughout the movement. Palpation of the patient's lumbar region revealed hypertonicity of the paraspinals in the lumbar and low thoracic region. Joint mobility testing using posterior-anterior (PA) glides of the lumbar spine was deferred due to guarding and pain with light palpation, but thoracic spine was found to be generally hypomobile with PA glides.

Special testing revealed normal neural testing with (-) straight leg raise and (-) slump testing. The FABER (flexion, abduction, and external rotation) test was (+) for mobility deficits with his knees bilaterally reaching 14" above the table, but it did not recreate lumbar symptoms. The FADIR (flexion, adduction, and internal rotation) test was (-), as was prone instability testing.

The examiner then evaluated the patient from a regional interdependence standpoint. The evaluating therapist used the Selective Functional Movement Assessment (SFMA). This tool is based on 10 multi-segmental movements that aim to identify mobility and stability deficits. Once the multi-segmental deficits are identified, the movements are further broken down with a joint-by-joint approach to identify specific impairments. The SFMA has been found to have high intra- and interrater reliability with experienced practitioners.[25] Appendix A shows a SFMA.

Using goniometric measurements and special testing, the patient being evaluated was found to have deficits at the hips and lumbar spine. His Thomas test was (+) bilaterally, R > L with bilateral abduction and external rotation at the hip, indicating tension in the antero-lateral hip region. Additionally, passive hip external rotation measured in a prone position was 25° bilaterally.

The treating therapist screened the thoracic spine, hips, knees, ankles, cervical spine, and shoulder as part of the SFMA evaluation and found no other impairments in the regions (Table 1).

Diagnosis and Prognosis

Upon completion of the examination, the therapist concluded that the patient's low back pain was likely a result of regional interdependence impairment. The origin of dysfunction stemmed from poor anterior and rotatory hip mobility, which was resulting in abnormal kinematics through the lumbar spine during rotational activities. This was seen functionally with painful swinging of a baseball bat or hockey stick, as well as sagittal plane dominated motions such as running.

At this point, it could not be ruled out whether a spondylogenic lesion was present, and therefore hyperextension treatments, such as repeated extension in standing or when lying prone were avoided. Due to caution of avoiding the possibility of a pars interarticularis stress fracture, it was also believed to be advantageous to avoid lumbar manipulations.

This ruled out the possibility of 2 treatment categories as described by Fritz et al's[6] treatment-based classification. Hicks et al's[7] subgrouping for instability was also inconsistent with this patient's symptoms. The findings for this patient in relation to the subgrouping were

- average straight leg raise > 91 (No),
- (+) prone instability (No),
- aberrant movement tested (No), and
- age < 40 (Yes).

Finally, there were no signs of a (+) crossed straight leg raise, and although the patient did appear to get worse with extension-based activities, there were no neural symptoms to suggest that traction may be beneficial.[26] Therefore, we proceeded with the diagnosis of low back pain secondary to a regional interdependence impairment, with caution of spondylogenic lesion if symptoms did not improve.

INTERVENTION

Treatment Sessions 1 and 2

The treating therapist's initial manual interventions were aimed at improving

Table 1. Initial Evaluation Summary of Findings

Range of Motion	Lumbar Flexion	25% restriction
	Lumbar Extension	75% restriction with hinge at L3/4 and 6/10 pain
	Lumbar Side Bending	25% restriction
	Thoracic Rotation	No restriction
	Passive Prone Hip External Rotation	25° bilaterally
	Hamstring	65° measured at hip angle
Joint Mobility	Lumbar	Guarded: unable to accurately assess
	Thoracic	Hypomobile through middle thoracic; normal upper and lower
	Hips	Normal bilaterally all directions
Special Testing	Straight Leg Raise	(-) Bilaterally
	Slump	(-) Bilaterally
	Prone Instability	(-)
	Flexion, Abduction, External Rotation	(-) for pain, but restricted with the knees 14" above the table bilaterally
	Flexion, Adduction, Internal Rotation	(-) Bilaterally
	Thomas Test	(+) Bilaterally, right > left with excessive hip abduction and external rotation
Palpation	Lumbar/Thoracic	Hypertonicity and pain at thoracolumbar junction and lumbosacral junction
	Hip and Thigh	Hypertonicity without pain rectus femoris and tensor fascia latae

lumbar and thoracic soft tissue mobility, decreasing hypertonicity and thereby leading to improvement in pain levels. An initial goal was to reduce pain levels through both a local and regional approach. The literature has shown motor control impairments or muscle atrophy in the lumbar spine correlate with both acute injury and chronic pain.[27,28] Reducing symptoms at the source of the pain was hypothesized by the author to reduce the ongoing motor control dysfunction and allow an opportunity to re-educate proper mechanics.

The exercise interventions focused on returning hip mobility and re-educating the transverse abdominis (TA) and multifidi. Literature has shown that the TA may show a delay in activation when performing functional tasks.[29,30] To address this, the author used basic movements such as an abdominal crunch, with a preactivation of the TA.

The patient additionally addressed hip mobility through foam rolling, hip flexor stretching (Figure 1), and then reinforced this with balance activities in positions where the hip flexors were lengthened and therefore inefficient to be used as stabilizers (Figure 2).[31] The goal of these activities were to decrease the need for hip flexor activation in preparation for later progressions in a standing position during running and swinging a baseball bat or hockey stick. The patient's impairments were bilateral and therefore treated bilaterally with a goal of creating functional mobility and symmetry. If the clinician or patient noted increased difficulty or greater restriction on one side, repetitions were added to the more involved side.

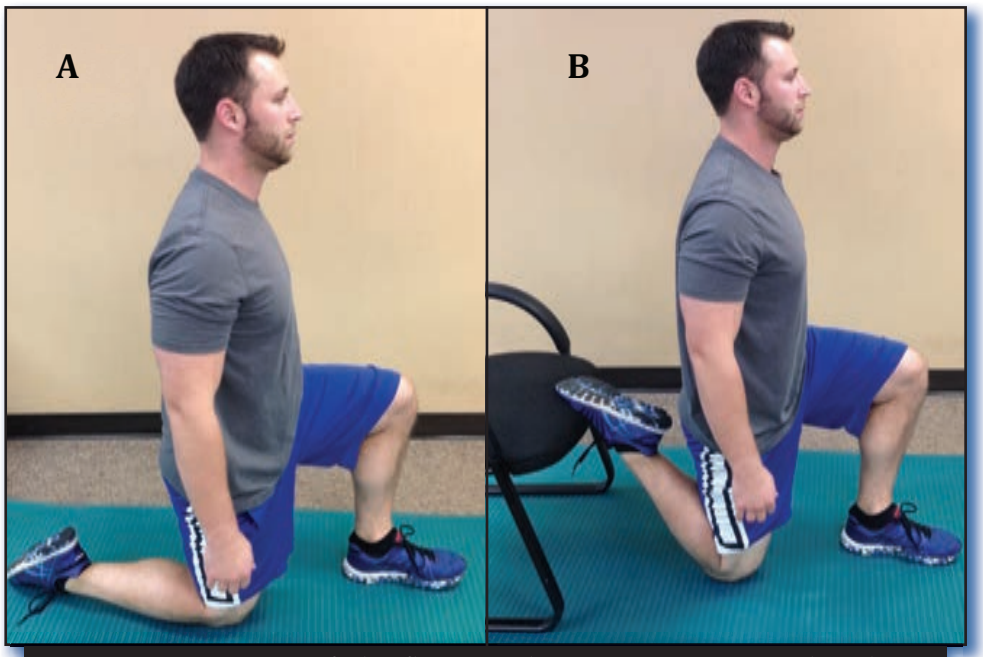

Figure 1. Demonstration of a hip flexor stretch. Focus is on posterior pelvic tilting to achieve pelvic neutral, while activating gluteals and lengthening the iliopsoas and rectus femoris. A, demonstrates a focus on iliopsoas. B, increases tension on rectus femoris by adding greater knee flexion. Caution is taken to avoid creating an excessive lordotic curve.

Treatment Session 3

The patient returned for his third treatment session 12 days following initial evaluation. He reported that he played in 2 hockey games in the previous 3 days with no symptoms remaining after the first game and only minimal symptoms that dissipated in about 1 hour following the second game. His Global Rating of Change (GROC) was a 4. The GROC is a 15-point Likert Scale used to objectively assess a patient's subjective recovery level. It ranges from -7, a very great deal worse, to 0, about the same, to 7, a very great deal better. A 4 represents moderately better.[32]

Patient re-evaluation showed an improvement in lumbar extension to only 25% limitation with decreasing pain vs 75% at initial evaluation. These results led the physical therapist to believe the patient's symptoms were not likely from spondylogenic origin. While lumbar extension continued to improve, his Thomas test, while improving, was slow despite a strict alliance with foam rolling and stretching of the hip flexors, quadriceps, and tensor fascia latae (TFL). A review of the golf literature would suggest that if a patient does not recover hip mobility, the rotational forces of swinging are likely to be transferred from the hips to the lumbar spine, which may place the athlete at an increased risk for re-aggravation of symptoms.[18,33] Therefore, the physical therapist elected to increase attention to returning hip mobility, using a soft tissue with movement technique to the TFL, vastus lateralis (VL), and rectus femoris (Figure 3).

The patient was placed in a Thomas test position and alternated flexion and extension of the knee to address the rectus femoris and VL, while the physical therapist applied pressure to hypertonic tissues. The patient then internally and externally rotated the hip while the therapist directed pressure to the TFL. While the TFL is a uniarticular muscle, its distal attachment of the iliotibial (IT) band extends below the tibiofemoral joint. Placing the athlete in a position that lengthens both the IT band at the knee and the TFL at the hip may be more advantageous to improving mobility so the Thomas position was selected.

The patient began to progress past balancing in a half-kneeling position, to rota-

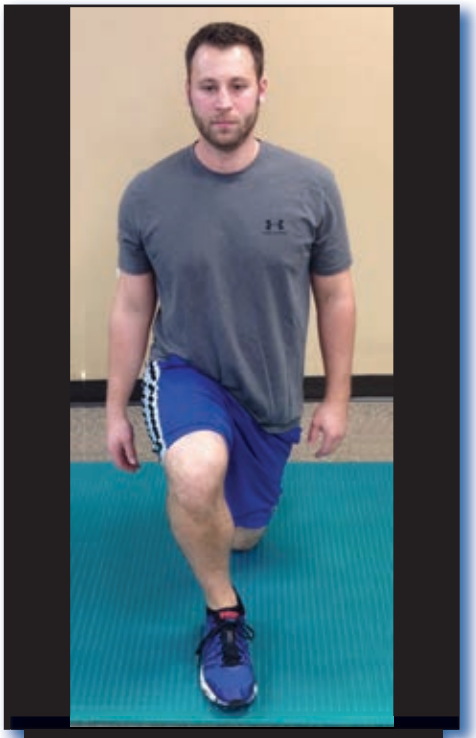

Figure 2. Demonstration of a stabilization progression. The iliopsoas and rectus femoris are placed in an inefficient position to contract by placing them in a lengthened position on the posterior leg. The gluteals are contracted and act as stabilizers. The base of support is narrowed to increase difficulty.

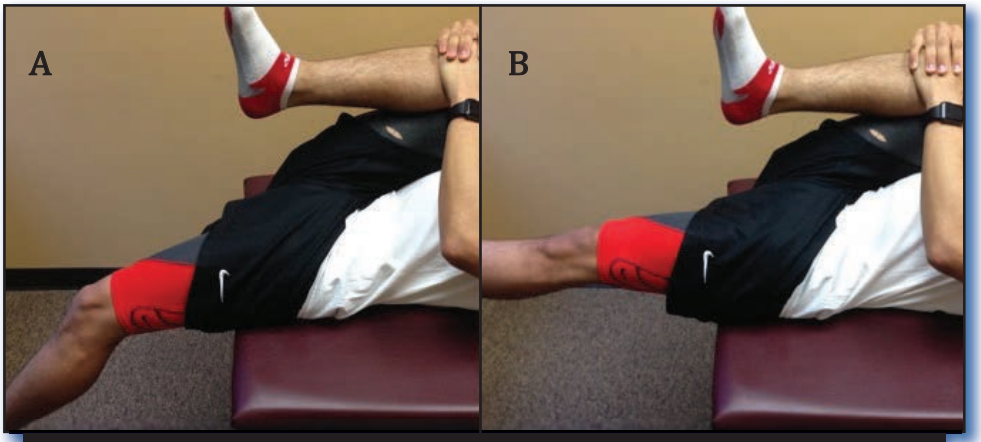

Figure 3. The Thomas Test position can be used to both measure and treat an anterior thigh musculature mobility deficit. Pressure was applied to the area of the palpated trigger points while the athlete moved the knee through flexion and extension. This can also be used to bias the tensor fascia latae by placing pressure through the tensor fascia latae and having the patient actively move the hip through external and internal rotation. A, the stretched position. B, the shortened position.

Figure 4. Demonstration of a stabilization progression. The iliopsoas and rectus femoris are placed in an inefficient position to contract by placing them in a lengthened position on the posterior leg. The gluteals are contracted and act as stabilizers. The thoracic spine is then rotated to improve coordination of thoracic spine motion on a stable lumbar spine and hip. A, rotation to the right. B, rotation to the left. The patient rotates side-to-side, focusing on maintaining stability at the lumbar spine and lower body with the upper body moving.

tional activities in half kneeling. This was believed to require the patient to begin simulating sport-like movements, while still in an inefficient position for the iliopsoas and rectus femoris to act as stabilizers. During this treatment, the patient focused only on initiating thoracic active range of motion rotation in this position, while maintaining a narrow base of support (Figure 4).

Quadruped reaching activities were also added to engage the multifidi and gluteal activation through a full range of hip extension. This was verbally cued carefully to avoid hip extension leading to lumbar hyperextension.

The patient also began hitting off a tee. He was preparing to transition from hockey to baseball for his high school spring sports season.

Visit 4 and 5

The patient continued to progress with his ODI improving from 16% at evaluation to 6% by visit 5. His GROC improved to a 5, quite a bit better. He noted that this would be even better, but he felt slightly tight during an all-day baseball practice. The weather was very cold and his back seemed to be fine except when he was not moving as much. He thought the tight feeling was due to the cold and not his injury.

The treating physical therapist found only a 10% deficit in rotation and lumbar extension at the beginning of treatment. Minimal remaining soft tissue deficits were found at the hip, lumbo-sacral, and thoraco-lumbar junction. All joint mobility showed a normal spring and endfeel. His gluteus maximus, medius, and minimus showed trigger points that were addressed through trigger point release and contract-relax stretching. After addressing these impairments, he showed no deficits in hip or lumbar range of motion and these motions were painfree.

His functional activities were progressed at visit 4 initiating half-kneeling chopping with resistance (Figure 5). At visit 5, this was progressed to include both half kneeling and standing to simulate swinging, while preventing movement through the lumbar spine. Various single leg activities were added with the goal of engaging gluteus maximus to provide strength and gluteus medius and minimus as stabilizers: Single Leg Romanian Dead Lift (RDL) and Single Leg Rotation. He also progressed through further return-to-sport activities in the clinic, such as multi-directional lunging and step-ups.

Visit 6

The patient cancelled his initial sixth visit appointment noting that he was not feeling well; however, he rescheduled this appointment for 2 days later. He had now been symptom-free with all activities of daily living, including sitting in class and full participation in baseball. A recheck of symptoms was planned along with a Functional Movement Screen (FMS) in preparation for a possible transition to a home exercise program. The FMS has been shown to have high interrater reliability.[33] It is comprised of 7 multi-segmental movements of the body with a maximum score of 21. A score of 15 or higher has been shown to be a normal injury risk, while 14 or below is an elevated risk.[35,36]

One month after initial evaluation when the patient arrived for visit 6, his personality appeared altered and he seemed to be generally fatigued. When the treating therapist inquired, the patient noted that he had donated blood 2 days prior. After donating blood, he became light-headed, resulting in a fall where he hit his head.

The treating therapist performed a concussion screen on the patient and noted altered balance and ocular-motor move-

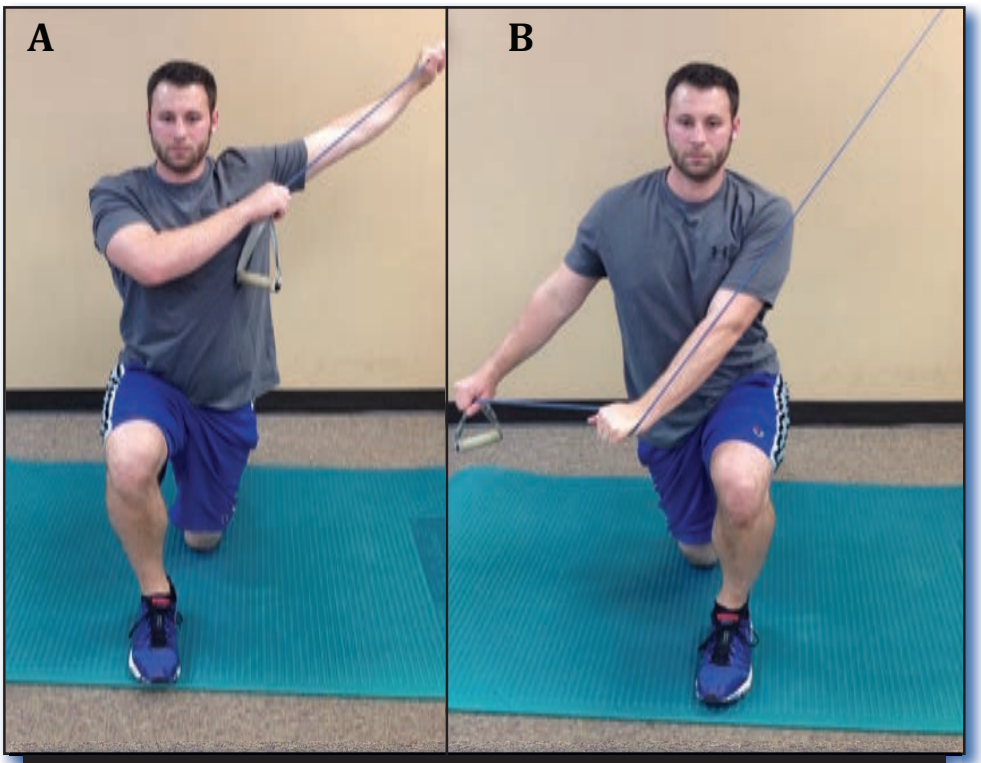

Figure 5. An external load is added, requiring stabilization to avoid loss of balance. The hip flexors are in an inefficient position to contract, preventing them from becoming stabilizers and therefore requiring stabilization from the gluteals and deep core musculature. This is used as a progression to chopping in standing and swinging a bat, racket, club for sports requiring swinging. A, the starting position. B, the ending position.

ments, as well as multiple subjective complaints consistent with a concussion. The patient noted that he did not want to bring up the symptoms to anyone and had not mentioned them to his parents, coaches, athletic trainer, or teachers. The referring sports medicine physician and school athletic trainer were contacted to note the findings and hold him from participation in sports. The referring physician diagnosed the athlete with a concussion and held further physical therapy appointments and sports participation.

Visit 7

The patient returned to physical therapy, under the physician's orders,1 month following the concussion (2 months since initial evaluation), after completing the required return-to-sport progression. The patient reported having competed in multiple practices and games without concussive or low back symptoms. His GROC was a 7, indicating a very great deal better. His ODI was a 0%, which indicates no disability remained. The patient completed the FMS with a score of 17/21, placing him at low-risk for reinjury.[35,36] A home exercise program focusing on hip flexor stretching, core exercises with the hip flexors in an insufficient position (chops in kneeling), and single leg RDLs for gluteal activation was prescribed. The patient was then discharged from physical therapy.

OUTCOMES

The patient was seen for 7 visits over an 8-week period and demonstrated a full resolution of all symptoms as measured by functional outcomes. A GROC of 7 is the highest obtainable score and is consistent with the ODI results. His ODI of 0% signifies a full recovery with no remaining disability and a 16% decrease from initial evaluation far exceeds the MCID of 6%.[24]

DISCUSSION

The purpose of this case report was to describe clinical reasoning and outcomes using regional interdependence in an adolescent athlete with low back pain. Initial interventions were aimed at reducing symptoms locally, with progression of treatment addressing the kinetic chain involved in sports. Treatment addressed areas of poor mobility, most notably the hips to decrease the strain through the lumbar spine.

Lead hip mobility has been noted to be an issue in professional golfers,[18,34] but has not been described for batters in baseball. The author believes the correlation of the lead hip and back is due to the abrupt end-feel of the lead hip when a golfer is decelerating after striking the ball. This has been well-documented in pitchers' shoulders as they attempt to decelerate when there is a decreased total arc of motion through the loss of internal rotation mobility.[20] When describing this phenomenon to patients or health care professionals, the author uses the analogy of a large airplane landing on a long vs short runway. On a long runway the plane would having no issue stopping. If however, that same plane is required to land on the shorter runway of a jet craft carrier, then there would not be enough room to decelerate and a problem is inevitable. The inadequate distance during landing is analogous to having inadequate motion in the shoulder or lead hip.

Another common finding in athletes is an anterior pelvic tilt, which has been correlated to increased activation of the erector spinae, decreased activation of the gluteals, and delayed onset of the gluteals. This can be addressed through stabilization exercises, which have been shown to improve both the delay and lack of activation.[37,38] To address the mobility impairments that may be present at the anterior hip, we prefer to use foam rolling or another form of soft tissue mobilization, followed by stretching in the half-kneeling position. This requires control of the pelvis while also addressing iliopsoas and rectus femoris mobility.

Half kneeling is also used to retrain normalized core stabilization. The literature has shown that when a muscle is placed in a lengthened position, it is inefficient at generating force.[31] Because the kneeling leg is lengthened at both the rectus femoris and the iliopsoas, it puts these muscles at a mechanical disadvantage to stabilize the core. The athlete receives instant feedback in the form of loss of balance or loss of pelvic alignment when stability is lost. This is believed to functionally retrain local core musculature initially.

Further progression can include more dynamic movements where an external load is used through chopping in half kneeling. Finally, the athlete returns to chopping in standing and swinging a bat.

The findings of this case report support the use of a regional interdependence

approach to back pain in the athletic population. However, due to the limitations inherent in case reporting, we cannot draw a cause and effect conclusion. A larger case series, with multiple athletes, would be beneficial in demonstrating the effects of treatment through regional interdependence. Additionally, higher-level research should compare treatment using regional interdependence with other current standards of care, including treatment-based classification, repeated motion testing, and core stabilization training.

The author believes that the current findings would not contradict current treatment-based classification as suggested by Fritz et al,[6] but instead begins to fill the gap in findings where 25% of the subjects were not included in a group.[8]

It should also be noted that the patient presented to physical therapy with a script that read, "possible spondylogenic lesion." In these cases, the author elects to proceed with caution if repeated extension testing or manipulation is being considered, which may preclude some treatments common in adults from comparison in this population. Palpation and special testing for spondylogenic lesions is poor, limiting our ability to rule out and continue with these forms of treatment.[10,39]

CONCLUSION

This case report described the clinical reasoning and treatment for an adolescent athlete with back pain who was treated with a regional interdependence approach. The outcomes show significant improvement in mobility and functional status over a limited number of treatments. This suggests a potential benefit of including a regional interdependence approach in athletes with back pain. Further research needs to be performed in adolescents with low back pain, comparing other leading interventions prior to conclusions about the effectiveness of this approach.

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#111 Advanced Level Biomechanics course of the Foot and Ankle Brian Hoke, DPT, SCS
July 22-23, 2017 Atlanta, Ga
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#147 Evaluation and Management of the Lumbar/SIJ/Hip Complex
Brian T. Swanson, PT, DSc, OCS, FAAOMPT
October 1-2, 2016 Brooklyn, NY
November 5-6, 2016 Winston Salem, NC

#149 Biomechanical Assessment and Treatment of the Cervical Spine & Shoulder Dysfunction
Michael Timko PT, MS, FAAOMPT
October 7-8, 2016 San Diego, CA
November 5-6 2016 Houston, TX

#179 OSTEOPOROSIS The MEEKS Method ™: Treatment Strategy Level 1
With Frank J. Ciuba, DPT MS
November 19-20, 2016 Brooklyn, NY
November 5-6, 2016 Corpus Christi, TX
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Appendix 1. Selective Functional Movement Assessment (SFMA)

The SFMA is a full-body assessment to determine movements which demonstrate limited motion, pain, or both. The initial test is made up of 10 multi-segmental movement patterns. The patterns found to be dysfunctional or painful are then further broken down with a joint-by-joint approach to determine patient limitations.

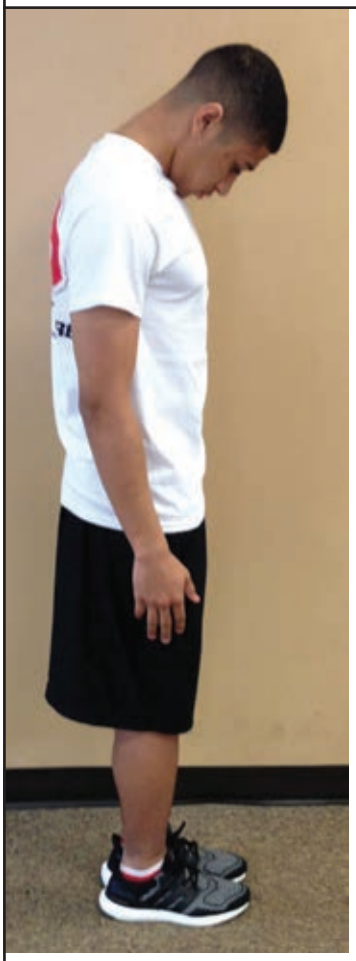

Figure A1. Cervical Flexion: Patient actively flexes neck. Functional movement is seen when the chin makes contact with the sternum.

Figure A2. Cervical Extension: Patient actively extends neck. Functional movement is seen when the head reaches near horizontal.

Figure A3. Cervical Rotation-Lateral Bend: Patient actively rotates neck to one side. The chin is then flexed downward towards the clavicle. Functional movement is seen when the chin contacts the clavicle. The test is repeated on the opposite side.

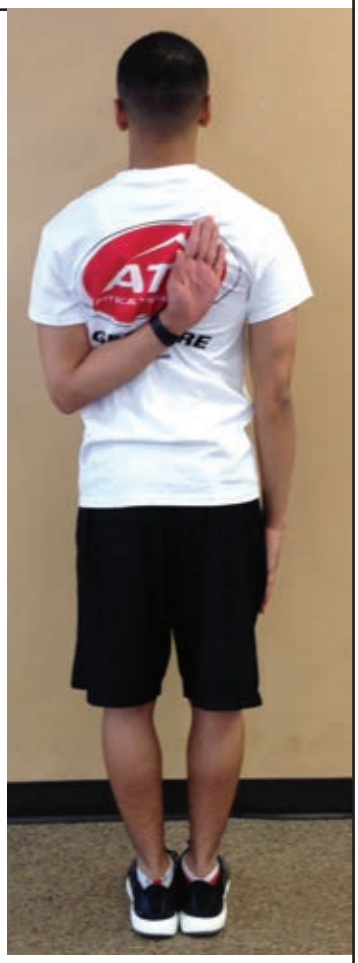

Figure A4. Upper Extremity Pattern 1: The hand reaches behind the back to the contralateral scapula to target shoulder extension and internal rotation. Functional movement is seen when the hand is able to reach the scapula. The test is repeated on the opposite side.

(Continued on page 261)

Figure A5. Upper Extremity Pattern 2: The hand reaches behind the neck to the contralateral scapula to target shoulder flexion and external rotation. Functional movement is seen when the hand is able to reach the scapula. The test is repeated on the opposite side.

Figure A6. Multisegmental Flexion: While standing with the feet together, the patient actively bends forward to touch his/her toes. A functional pattern is demonstrated when the toes are touched, the knees are kept straight, and a uniform curve of the spine is seen.

Figure A7. Multisegmental Extension: While standing with the feet together and the arms flexed above the head, the patient actively bends backwards as far as he or she is able. A functional pattern is demonstrated when the anterior pelvis moves beyond the front of the toes, the spine of the scapula moves posterior to the heels, and a uniform spinal curve is maintained.

Figure A8. Multisegmental Rotation: While standing with the feet together and the arms relaxed to the side, the patient actively rotates as far as he or she is able. A functional pattern is demonstrated when the pelvis rotates 50°, the shoulders rotate 50°, and there is no pelvis or spine deviation to the side.

Figure A9. Single Leg Stance: While standing with the feet together, the patient flexes one hip to 90° while standing on the opposite foot. This position is held for 10 seconds. It is then repeated again with the eyes closed. A functional test is seen when the patient is able to maintain both positions for 10 seconds without loss of balance or significant sway. The opposite side is then tested.

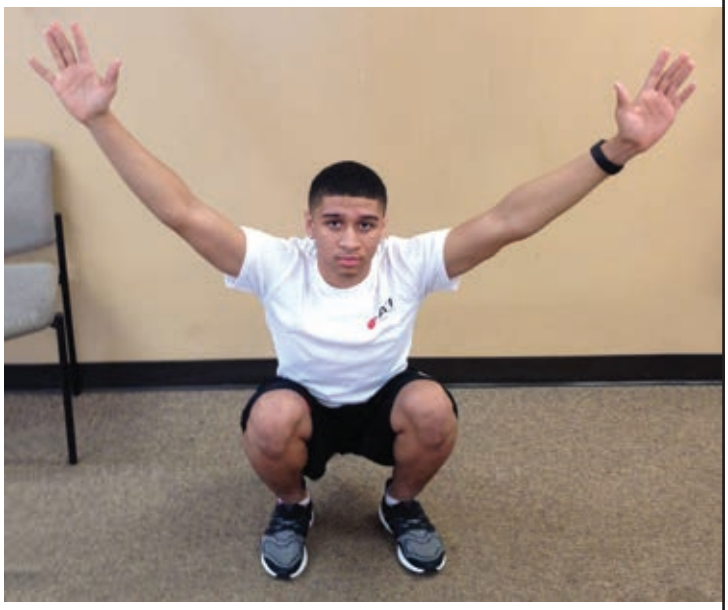

Figure A10. Overhead Deep Squat: The patient stands with the feet shoulder width apart and pointing straight forward. The arms are placed overhead. The patient descends downward into a squat as low as they can go. A functional test is seen when the thighs pass below horizontal, the knees remain in line with the hips and feet, and the trunk does not flex forward past the angle of the tibia.

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Orthopaedic Section Awards

Now is the Time to Nominate!

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

James A. Gould Excellence in Teaching Orthopaedic Physical Therapy Award

Outstanding PT & PTA Student Award

Paris Distinguished Service Award

Richard W. Bowling - Richard E. Erhard Orthopaedic Clinical Practice Award

Plan to nominate an individual for one of these highly-regarded awards!
http://www.orthopt.org/content/membership/awards

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2016 Honors and Awards Recipients

Congratulations to the Orthopaedic Section members who recently received Honors and Awards from the American Physical Therapy Association.

Catherine Worthingham Fellows of APTA:
Tara Jo Manal, PT, DPT, OCS, SCS, FAPTA
Guy Simoneau, PT, PhD, ATC, FAPTA
Carol Jo Tichenor, PT, MA, honFAAOMPT, FAPTA
Stephen C.F. McDavitt, PT, DPT, MS, FAAOMPT, FAPTA
Linda Resnik, PT, PhD, MS, FAPTA
Linda Van Dillen, PT, PhD, FAPTA

PRACTICE & SERVICE AWARDS
Lucy Blair Service Award:
Linda E. Arslanian, PT, DPT, MS
Anthony DiFilippo, PT, DPT, Med, OCS

Henry O. and Florence P. Kendall Practice Award:
Nancy J. Bloom, PT, DPT, MSOT

PUBLICATIONS AWARDS
Chattanooga Research Award:
Leland E. Dibble, PT, PhD et al. Toward Understanding Ambulatory Activity Decline in Parkinson Disease

Jack Walker Award:
Keith G. Avin, PT, PhD, Christine M. McDonough, PT, PhD, et al. Management of Falls in Community Dwelling Older Adults: Clinical Guidance Statement form the Academy of Geriatric Physical Therapy of APTA

Helen J. Hislop Award for Outstanding Contributions to Professional Literature:
Julie Fritz, PT, PhD, FAPTA

Jules M. Rothstein Golden Pen Award for Scientific Writing:
Steven Z. George, PT, PhD

RESEARCH AWARDS
Eugene Michels New Investigator Award:
Cara L. Lewis, PT, PhD
Laura C. Schmitt, PT, MPT, PhD

Marian Williams Award for Research in Physical Therapy:
John D. Childs, PT, PhD, MBA, FAPTA

EDUCATION AWARDS
Dorothy E. Baethke-Eleanor J. Carlin Award for Excellence in Academic Teaching:
Rob Landel, PT, DPT, OCS, CSCS, MTC, FAPTA

Signe Brunnstrom Award for Excellence in Clinical Teaching:
John R. Seiverd, PT, DPT, CCCE/CI

MARY MCMILLAN SCHOLARSHIP AWARD
Physical Therapist Student Scholarship:
Fred Gilbert, SPT, University of Alabama at Birmingham

Physical Therapist Assistant Student Scholarship:
Travis Nelson Dills, SPTA, Somerset Community College
Matthew Gratton, SPTA, University of Saint Francis

2016 MINORITY SCHOLARSHIP AWARD
Physical Therapy Student Scholarship:
Samantha Van Gorder, SPT, Duke University

Our own Orthopaedic Section Board Members—Nancy Bloom and Stephen McDavitt—were honored at the Honors and Awards program this past June in Nashville, TN. Nancy Bloom, Education Program Chair for the Orthopaedic Section, received the Henry O. and Florence P. Kendall Practice Award and Stephen McDavitt, President of the Orthopaedic Section, was named a Catherine Worthingham Fellow. *Congratulations!*

Book Reviews

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

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

Low Back Disorders: Evidence-Based Prevention and Rehabilitation, 3rd Edition, Human Kinetics, 2016, $84
ISBN: 9781450472913, 404 pages, Hard Cover

Author: McGill, Stuart, PhD

Description: This is an update of a guide to the assessment and treatment of low back pain with an emphasis on evidence-based research. The previous edition was published in 2007. Much of the format and references remain the same, as do many of the illustrations. The section on the use of back belts is identical to the previous edition. However, the exercise handouts and online videos of various tests and techniques are new to this edition. **Purpose:** The author states that the purpose is not to perpetuate clinical myths, but to challenge them and propose valid and scientifically justifiable alternatives. As the personal cost, as well as the cost to society in general, of low back pain increases, it is obvious that the care for patients with low back pain needs to improve. The online addition of the treatment and evaluation techniques as performed by the author allows the readers to see the techniques being applied. **Audience:** This book is intended for any clinician who examines and treats patients with low back pain. Stuart McGill is an internationally recognized authority in spine function, injury prevention, and rehabilitation, as well as a well-published researcher and author. **Features:** Part one of the book's three parts, on the scientific foundation, has five chapters that examine the research behind low back pain, the anatomy and mechanics of the lumbar spine, and the issue of lumbar spine stability. Part two has two chapters on injury prevention, which do a thorough job of explaining the various methods to assess occupational risk factors. Part three, on rehabilitation, includes the evaluation and development of exercise programs. This section is augmented by videos on the website. Each chapter has a summary section, and key concepts are highlighted in clinical relevance sections. **Assessment:** Accessing the online ancillaries requires creating an account, which is easy. I had to contact technical support to get into the ancillaries for the book, which was very helpful and responded quickly. The exercises are on PDF files that can be copied and individualized for the patient. Videos demonstrate different exercise and evaluation techniques.

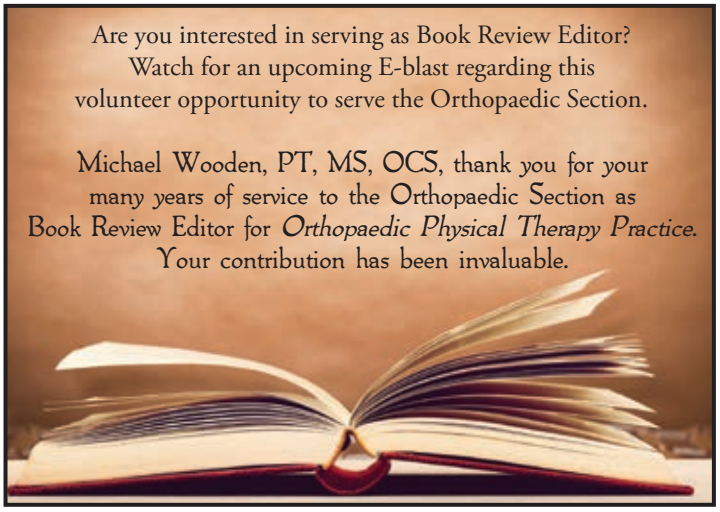
Jeff B Yaver, PT
Kaiser Permanente

Manual Therapy of the Extremities, Jones & Bartlett Learning, 2017, $99.95
ISBN: 9781284036701, 352 pages, Spiral Cover

Editor: Shamus, Eric, PT, DPT, PhD; van Duijn, Arie J., PT, EdD, OCS

Description: This book and accompanying online resource describe eight different manual therapy techniques for improving osteokinematic motion in the extremity joints. **Purpose:** The stated purpose is "to provide a comprehensive resource for the teaching and learning of a variety of types of manipulation techniques for the extremity joints." Due to the different presentations of patients with similar diagnoses and movement dysfunctions, the authors wanted to provide a resource highlighting a variety of manual techniques. The organization of the book mimics the clinical practice of manual therapy by using an eclectic approach. The book's accompanying website includes additional resources for teaching manual therapy, including PowerPoint slides, quizzes, videos, and flashcards. **Audience:** The audience includes students, clinicians, and educators. The descriptions of the eight different manual therapy techniques are thorough and provide a good introduction for students as well as clinicians. The authors are experienced manual therapists and educators. **Features:** The first chapter introduces seven different manual therapy techniques, which include nonthrust joint manipulation, thrust joint manipulation, muscle energy technique, manipulation with movement, counterstrain technique, myofascial manipulation, and soft tissue manipulation. The following chapters are organized by extremity, and further organized by motion restriction. Each motion restriction includes seven manual therapy techniques as well as descriptions and pictures of the eighth, self-mobilization. The organization of the book makes is easy to use clinically and aids in students' understanding and clinical reasoning. The book also includes a case study for each extremity region with current evidence for manual therapy. **Assessment:** This is a good resource for anyone interested in learning manual therapy techniques as well as for therapists who practice manual therapy techniques. The organization is unique in the way it presents several different techniques to improve motion, making it a practical resource for clinicians. Most useful and unique is the inclusion of patient self-mobilization. The book pairs well with the website, particularly for students and educators. I would recommend this book for students as well as seasoned clinicians.

Monique Serpas, PT, DPT, OCS
Touro Infirmary



OCCUPATIONAL HEALTH

SPECIAL INTEREST GROUP

RESOURCES FOR THE PHYSICAL THERAPIST WORKING TO PREVENT MUSCULOSKELETAL HAZARDS IN THE WORK PLACE AND TREAT THE WORKER FOLLOWING INJURY

The Occupational Health Special Interest Group is breaking with tradition in this edition of *Orthopaedic Physical Therapy Practice*. This space typically includes original articles and research from our members. This specialty practice requires communication with multiple stakeholders, outside of a traditional medical model. Related organizations share information, publish research, and host conferences. These groups may provide opportunities for speaking, sponsorship, or networking. Local chapters look for presenters at regularly scheduled meetings. The descriptions of these organizations have been taken directly from the published information at the respective website. This is not a complete list. Members are encouraged to share additional resources with the group. The information below is intended for those interested in providing work place safety initiatives and in the rehabilitation of workers with injuries.

Orthopaedic Section, APTA: Occupational Health Special Interest Group (OHSIG)

Web address: https://www.orthopt.org/content/special_interest_groups/occupational_health

If you are not a member of the SIG, go to the Orthopaedic Section website, special interest group page, and sign up. It is a benefit of your membership in the Section. The OHSIG is recognized as a leading authority in occupational health physical therapy. The SIG leads by providing professional development, sharing current information, identifying opportunities for outreach and collaboration, and supporting practice and research initiatives. Look up members in your area through the OHSIG web page. Literature review and Podcasts are shared by way of quarterly emails. These are also available for you to review in the archives on the Orthopaedic Section - OHSIG web page.

Facebook group: The OHSIG hosts a Facebook page, limited to OHSIG members. This is a platform to exchange information related to occupational health, work rehab, regulatory issues, upcoming conferences, etc. Request to join at Facebook.com, searching for the Occupational Health SIG.

EDUCATIONAL OPPORTUNITIES

Occupational Health Building A Successful Practice the Right Way:

This is the first in a series of courses that will be offered by the OHSIG. Members should have received information regarding this course scheduled to take place in Chicago, October 14, 2016. If you did not receive this information, please sign up again as a member of the OHSIG at the web page address listed above. These courses will implement the guiding statements that will be presented at CSM 2017 (see below).

Preconference Course:

Functional Capacity Evaluation, Onsite PT, Job Analysis: What You Need to Know: This preconference course will be sponsored by the Orthopaedic Section, APTA, at the Combined Sections Meeting (CSM) in San Antonio, Texas, Tuesday and Wednesday, February 14-15, 2017, from 8:00 a.m. – 5:00 p.m. Watch for the opening of registration. Participants will need to be registered for this course by December 1, 2016.

Evidence-based Physical Therapy Clinical Practice Guideline for Work Rehabilitation: You will want to attend the OHSIG Membership Meeting, during CSM in San Antonio. Be the first to get an overview of the Evidence-based PT Clinical Practice Guideline for Work Rehabilitation. The CPG has been a 3-year process, giving guidance to physical therapists based upon clinical research. The implementation plan including educational offerings in best practice will be presented.

Evolving Paradigms In Psychosocial Management of Debilitating Pain Conditions: This session is included during regular programming at CSM. Presenter Michael Sullivan, PhD, is the developer of the Progressive Goal Attainment Program, "P-GAP." Other meetings of interest during CSM include the Work Rehab CPG meeting, Wednesday, 4:00-6:00 p.m. and the OHSIG Board meeting immediately following at 6:00-9:00 pm.

AMERICAN PHYSICAL THERAPY ASSOCIATION: DEPARTMENT OF PAYMENT AND PRACTICE MANAGEMENT

Web address: http://www.apta.org/Payment/WorkersCompensation/

Wanda Evans, PT, MHS, CKTP, is Senior Payment Specialist at APTA in the department of Payment and Practice Management. She is an invaluable resource keeping us up-to-date with the ever changing payment and policy issues pertaining to worker compensation systems. Find specific state resources on the web page listed above. The information may change. The APTA chapter representatives are asked to help keep the resource up-to-date.

The annual APTA State Policy and Payment Forum is preceded by a one day meeting to which payers are invited. The APTA Insurers' Forum brings together representatives from the insurance industry, including nurse case managers, medical directors, and payer representatives to discuss current practice and trends in physical therapy, case management, CPT coding, and to solicit feedback from the payer community regarding issues pertinent to physical therapist practice. The most recent annual insurers' forum was held September 16, 2016, in Pittsburgh, PA.

RELATED ORGANIZATIONS

The following descriptions are included on the organizations' web pages.

Workers Compensation Research Institute

Web address: wcrinet.org

The Workers Compensation Research Institute is an independent, not-for-profit research organization providing high-quality, objective information about public policy issues involving workers' compensation systems. Organized in late 1983, the Institute does not take positions on the issues it researches; rather, it provides information obtained through studies and data collection efforts, which conform to recognized scientific methods. Objectivity is further ensured through rigorous, unbiased peer-review procedures.

Society for Human Resource Management

Web address: https://www.shrm.org

Look for a chapter in your area. Regular meetings are held with invited speakers.

National Council of Self-Insurers

Web address: http://natcouncil.com

The National Council of Self-Insurers is an organization of corporate, state association, and professional members. The Council represents 3500 employers. The initial and primary interest of the National Council of Self-Insurers is workers' compensation and particularly self-insurance of the workers' compensation liability. It speaks at the national level on issues affecting both subjects. The Council also serves as a national education forum for employers and provides information to self-insured companies and state self-insurer associations. The 2017 NCSI Annual Meeting will be held in San Diego, CA, June 4-7, 2017.

Insurance Rehabilitation Study Group

Web address: http://irsghome.org/

The Insurance Rehabilitation Study Group's (IRSG) mission is to provide an educational forum for the insurance industry to explore and develop concepts and programs of effective medical and rehabilitation services that pertain to all lines of insurance. The vision of the IRSG is to serve as an innovative leader by promoting and advocating quality care and service delivery; through education and shared knowledge between members, the insurance industry, and the health care community.

American Society of Safety Engineers

Web address: www.asse.org

Founded in 1911, the American Society of Safety Engineers (ASSE) is the world's oldest professional safety society. The ASSE promotes the expertise, leadership, and commitment of its members, while providing them with professional development, advocacy, and standards development. It also sets the occupational safety, health, and environmental community's standards for excellence and ethics.

The ASSE is a global association of occupational safety professionals representing more than 36,000 members worldwide. The Society is also a visible advocate for OSH professionals through proactive government affairs at the federal and state levels, and in member-led relationships with key federal safety and health agencies.

Members create safer work environments by preventing workplace fatalities, injuries, and illnesses. Besides recording less lost time and lower workers' compensation costs, organizations with strong safety performance enjoy increased productivity, a better reputation, and higher employee satisfaction.

American College of Occupational and Environmental Medicine

Web address: www.acoem.org

Founded in 1916, the American College of Occupational and Environmental Medicine (ACOEM) is the nation's largest medical society dedicated to promoting the health of workers through preventive medicine, clinical care, research, and education. A dynamic group of physicians encompassing specialists in a variety of medical practices is united via the College to develop positions and policies on vital issues relevant to the practice of preventive medicine both within and outside of the workplace. While national in scope, the College is composed of local component societies in the United States and Canada, whose members hold scientific meetings and network on a regular basis. The ACOEM sponsors the annual American Occupational Health Conference, the nation's largest conference of its kind, each spring.

The College also conducts continuing education courses including Foundations in Occupational Medicine, Occupational Medicine Board Review and Impairment and Disability Evaluation, and offers training for MRO Drug/Alcohol Testing and Commercial Driver Medical Examiners. In 1997, ACOEM introduced the Corporate Health Achievement Award to recognize the finest health programs in North American companies.

ACOEM publishes the monthly *Journal of Occupational and Environmental Medicine*, ACOEM E-News, *MRO Update* newsletter, *CDME Review* newsletter, and books including the *Occupational Medicine Practice Guidelines*.

Many articles are open to access at the ACOEM website.

RELATED CONFERENCES AND MEETINGS OF INTEREST

National Ergonomics Conference and Ergo Expo

November 15-18, 2016, Caesars Palace, Las Vegas

3rd International FCE Research Conference was held September 28-29, 2016 in Wijk aan Zee, Netherlands. Web address: http://vroegeinterventie.nl/

International FCE Research Conference

The International FCE Research Conference serves as an international forum for research and knowledge implementation related to work assessment and functional capacity evaluations, across all causes of work incapacity. Participants include leading international experts in the field–scientists, clinicians, and other users of FCE information.

RESOURCES FOR ADDITIONAL INFORMATION

State departments of labor house policy resources, statute and rule information. A good example is Washington State Department of Labor and Industry. Web address: http://www.lni.wa.gov/. Washington Physical Therapists have been instrumental in helping employers, medical providers, and employees with research methods in prevention and treatment for persons with worker-related injuries.

Bureau of Labor Statistics: Web address: http://www.bls.gov/home.htm

The "Incidence Rate Calculator and Comparison Tool" can be found at http://data.bls.gov/iirc/. Use this to compare the injury rate of your client company with other like companies, before and after any intervention or services.

The **Occupational Requirements Survey (ORS)** is a survey conducted by the Bureau of Labor Statistics' (BLS) National Compensation Survey (NCS) program in association with the Social Security Administration (SSA). The ORS seeks to provide job characteristics data to help the SSA in their disability determination process. Specifically, the ORS will gather job-related information regarding physical demands, environmental conditions, mental and cognitive demands, and vocational preparation requirements.

The Center for Disease Control/National Institute of Occupational Safety and Health: Web address: http://www.cdc.gov/niosh/topics/safepatient/

Newsletters/Blogs: This information is provided for information only and is not intended to endorse any service or product.

Claimwire: Web address: https://www.claimwire.com/

Managed Care Matters: Web address: http://www.joepaduda.com/

PERFORMING ARTS

SPECIAL INTEREST GROUP

President's Letter

Annette Karim, PT, DPT, PhD, OCS, FAAOMPT

Being involved in the Performing Arts Special Interest Group (PASIG) has been a joy for me. I would like to extend the same opportunity to you. Membership is free to all Orthopaedic Section members and is one of the great perks of being in the Orthopaedic Section! To become a PASIG member, go to this link: https://www.orthopt.org/sig_pa_join.php

If you are already a member, please remember to update your membership:

https://www.orthopt.org/login.php?forward_url=/surveys/membership_directory.php

Please consider sharing your ideas. We are always looking for members who would like to become more involved. Every voice counts.

I began my journey with the PASIG as a poster presenter, then as a citation blast writer, then Research Chair, and I am now finishing out my 3-year term as President. I am amazed at the collaboration that has taken place to make new things happen, such as the movement from the newly-approved Description of Specialist Practice toward the Description of Fellowship Practice (DFP) for the performing arts, the awarding of a $15,000 research grant for performing arts research, the presence of the PASIG on social media, and the movement among our members in creating dancer screens, fellowships, and new performing arts research. All of these events, in addition to our CSM programming could not happen without the collaboration of our members, our Orthopaedic Section and PASIG leaders, and resource groups such as the American Board of Physical Therapy Residency and Fellowship Education (ABPTFRE). It has been a privilege to serve and to work with such talented and forward-facing people. Please join us and share your talents!

Board leadership positions that will be vacant are President, Nominating Committee member, and Scholarship Chair/Secretary. Please contact Janice Ying if you are interested or would like to nominate a candidate.

If you are interested in serving in a particular area, or teaching a conference course, or have a request for educational content at future courses, let us know! Contact Rosie Canizares for CSM or annual meeting content, and any of the PASIG Board members regarding serving on committee.

Interested in a Performing Arts Fellowship? The American Board of Physical Therapy Residency and Fellowship Education (ABPTFRE) has approved the PASIG Description of Specialist Practice (DSP) for the Performing arts as an area of study. We are now working with the ABPTFRE to turn the DSP into a Description of Fellowship Practice (DFP). This means that sites can begin forming fellowships in dance medicine, music medicine, theater medicine, etc. The PASIG will provide the fellowship criteria for accreditation. If you are interested, please contact Mariah Nierman or Laurel Abbruzzese. We are planning a meeting at CSM on Saturday, February 18, 2017, from 12:00 - 1:30 p.m. for those interested in more information. Please let us know if you would like to attend the meeting.

Keep up with us on Facebook by contacting Dawn Doran. It is a closed group, so you need to contact Dawn first. Keep up with us and post on Twitter: We are PT4Performers.

Interested in dancer screening? You are not alone. There are many clinicians and academicians who need to connect on this. Please let us know if you would like to participate in a meeting at CSM Thursday, February 16, 2017, at 1:00 pm. The meeting is specifically for connecting researchers with clinicians on dancer screening. Contact Mandy Blackmon.

CSM **February 15-18, 2017**
San Antonio, TX

CSM 2017 IS AROUND THE CORNER!

The PASIG programming is approved and it will be a great conference course: "A Guide to Upper Extremity Nerve Entrapment Syndromes in Musicians," by Janice Ying, DPT, OCS, Adriaan Louw, PhD, PT, CSMT, and Erin M. Hayden, PT, DPT, OCS

We hope to see you there!

If you are submitting a performing arts poster or platform to CSM 2017, please consider applying for our student scholarship, and contact Anna Saunders.

PASIG students are welcome to apply through the Orthopaedic Section for formal mentorship. Contact Megan Poll and cc Liz Chesarek if you are interested: meganpoll@gmail.com

We welcome monthly citation blast writers, students included! To do this, you find a topic of interest, then 10 article abstracts from the past 5 years, and write a couple of paragraphs explaining your interest and findings. That's it! So easy! Contact Laura Reising for more information.

Lastly, if you have an article that you would like to submit for publication in the PASIG pages *Orthopaedic Practice* magazine, please contact me (Annette Karim). *OPTP* is published 4 times a year. Author instructions can be found at:
https://www.orthopt.org/uploads/content_files/Downloads/OPTP/OP_Instructions_to_Author_3.16_FINAL.pdf

Thank you to Mandy Blackmon, our Dancer Screen Chair, for sharing her clinical expertise in Trigger Point Dry Needling in this issue of *OPTP*.

The Use of Dry Needling in the Treatment of Performing Artists

Mandy Blackmon, PT, DPT, OCS, CMTPT

The APTA defines dry needling (DN) as "a skilled intervention utilized by physical therapists that uses a thin filiform needle to penetrate the skin and stimulate underlying myofascial trigger points, muscular, and connective tissues for the management of neuromusculoskeletal pain and movement impairments."[1] Typically, DN is performed to target myofascial trigger points

Image courtesy of Google Images.

in muscle and is based on the work of Janet Travell, MD, David Simons, MD, and others.[2] However, in recent years, techniques have evolved to also target tendon, fascia, and scar tissue.[3] Dry needling techniques performed by physical therapists are different in both theory and practice from techniques performed by acupuncturists.[1] Although the APTA defines DN as within the scope of physical therapy practice, regulations vary by state and physical therapists are not allowed to practice DN in all states.[4] *Physical therapists are responsible for knowing the rules and laws in the state in which they practice.*

A trigger point (TrP) is a discrete and palpable nodule within a taut band of muscle that is exquisitely tender with mechanical stimulation.[5] The pain from a myofascial TrP may remain local or may refer to a different and remote part of the body. Trigger points may develop in muscle for a variety of reasons, including, but not limited to trauma, concentric muscle overload, eccentric muscle overload, prolonged postural overload, and repetitive low-load muscle activity.[5] With various constructs of muscle overload, an energy crisis occurs. Blood flow to the muscle fibers is restricted, causing a back-up or retrograde blood blow. This results in ischemia, decreased oxygenation to the tissue, and a lowering of pH, resulting in an acidic environment. This acidic environment results in a chemical cascade that will change thresholds and permeability of specific nociceptors. We know from in-vivo microdialysis of the area in and around the trigger point that concentrations of specific nociceptive chemicals are higher inside a myofascial trigger point, including adenosine triphosphate (ATP), bradykinin (BK), 5-hydroxytryptamin (5-HT, serotonin), prostaglandins, and potassium (K+).[6] We also know that electrical activity is increased near a trigger point, resulting in motor endplate noise.[7]

Trigger points may result in impairments including pain, range of motion restrictions, muscle inhibition, and changes in muscle activation patterns and motor control.[8] Any and all of these impairments may be addressed by treating the TrPs with DN. Historically, TrPs were treated by injection of various substances using a hypodermic needle. Current research demonstrates that DN, use of a small filiform needle, is as effective or more effective than TrP injections, without the potential side effects that may occur with medications commonly used with TrP injections.[9]

Although there is a paucity of research on the topic, DN is also being used to address tendinopathy and scar tissue with a variety of needle manipulations including pistoning and rotating. Current research hypothesizes that the mechanism for the effect is due to mechanical transduction signaling through connective tissue.[10] Pistoning of the needle may also stimulate blood flow to area to allow a re-initiation of the inflammatory and healing processes.

There is very little research available on the treatment of TrPs in performing artists. There are, however, several articles published recognizing that myofascial pain can be present in performing artists, particularly in the head, neck and upper extremities of vocalists and musicians.[11,12] These authors note that myofascial pain syndromes may mimic other neuromusculoskeletal diagnoses such as carpal tunnel syndrome, temporomandibular joint pathology, migraine headache, DeQuervain's tenosynovitis, arthritis, and ulnar nerve pathology, to name a few. For example, an ill-fitting string instrument may lead to compensations in the upper extremity that result in significant overload to extensor carpi radialis longus muscle and infraspinatus muscle, which could result in myofascial pain that imitates the pain complaints of DeQuervain's tenosynovitis.[2]

There is less literature to support existence of myofascial pain syndromes and the use of DN in the lower extremities in performing artists. However, in treating performing artists, we often see patients with complaints of heel pain and "plantar fasciitis." Clinicians should be aware of the contributing factors of muscle referred pain patterns in these diagnoses. For example, there are multiple muscles whose referral pattern mimics a plantar fasciitis-type pain: gastrocnemius, soleus, flexor digitorum longus, quadratus plantae, abductor hallucis, and tibialis posterior.[2,13] All of these muscles should be examined for myofascial TrPs in addition to the typical orthopaedic exam including active and passive range of motion, strength testing, selective tissue tensioning, special tests, posture and alignment, etc. Clinicians are beginning to get more case reports in the literature regarding the use of DN in treating dancers.[14] Clinicians should be encouraged to contribute to evidenced-based practice in this valuable way.

In all performing artists, it is important to look at the patient performing their specific task. Whether it is the posture and fingering of a violinist or relevé and landing mechanics of a classical ballerina, clinicians can gain important information regarding repetitive loading, sustained postural loads, and muscle imbalances that may be contributing factor to the development of trigger points and myofascial pain syndromes. A classic example is the violinist suffering from tension type headaches because of sustained cervical rotation that is causing TrPs in the suboccipital muscles or sternocleidomastoid muscle (SCM). In this case, bilateral SCMs, suboccipitals, as well as posterior cervical muscles and deep cervical flexors will need to be examined.

Is the dancer forcing hip turnout, overusing deep hip rotators, inhibiting the gluteal muscles, leading to increased valgus stress at the knee with landing jumps? In such a presentation, it would be important to examine and treat trigger points in the deep rotator muscles, gluteal muscles, adductor muscles, and quadricep muscle groups. In these cases, TrPs are a contributing factor to the pain complaints and must be addressed in addition to accessory joint motion, postural and motor control impairments.

Trigger points may also present as a result of acute injury. In the case of a dancer presenting with a lateral ankle sprain due to

a plantar flexed and inverted landing, the fibularis longus and brevis muscles may also respond with TrPs due to eccentric overload sustained during the injury. These TrPs may be the cause of persistent lateral ankle pain. In the case of an acute hamstring strain, the patient may present with TrPs in conjunction with swelling, range of motion, and strength impairments. If a dancer sustains a concussion and a whiplash injury during a performance, she may also present with TrPs in the sternocleidomastoid, deep cervical flexors, upper trapezius, and suboccipital and splenius capitus muscles.

Practitioners should keep in mind that TrPs can also be effectively treated without the invasive intervention of DN. If the physical therapist is practicing in a state whose practice act does not allow for use of needles, it is important to learn manual assessment and treatment techniques for trigger points. Sustained compression, with or without repeated contractions, may be used to treat most muscles in the body. There are also muscles in which DN may be a precaution or contraindication for a variety of reasons. For example, I do not teach DN of the posterior tibialis muscles secondary to anatomic anomalies seen in the neurovascular structures in the deep posterior compartment. I believe that needling this muscle may increase risk for bleeding and compartment syndromes. Precaution should always be taken in needling patients on anticoagulant therapy. However, needling muscles in which direct hemostasis cannot be applied, ie, lateral pterygoid and psoas, would be a contraindication with increased risk of bleeding.

In the case of pregnancy, needling in the first trimester and in and around the abdominal wall, lumbar spine, and pelvis may be discouraged. Localized or systemic infection, metastasis, breast or pectoral implants, communication barriers, and fear of needles are other example of cases in which manual treatment of TrPs may be used. In the case of a performing artist, DN may be avoided 24 to 48 hours prior to performance due to the potential for residual soreness and alterations in muscle firing and patterning. This is determined on a case-by-case basis and the patient's prior response to DN should always be considered.

As one of the physical therapy providers for a professional ballet company, I use DN frequently as part of holistic care for the performers. It is my experience that the dancers tolerate and respond very well to the intervention. In general, they are extremely aware of their bodies and notice even the slightest restriction in range of motion, strength, and ability to stabilize. From experience, most of the dancers prefer to be treated with needles at the end of their workday or even workweek so that they have time to recover. It is extremely rare that we provide DN interventions on a dancer on the day of performance. As with any intervention, DN and TrP treatment must always be used in conjunction with other manual therapies, therapeutic exercises, and neuromuscular re-education as appropriate.

Mandy Blackmon, PT, DPT, OCS, CMTPT, practices at Motion Stability Physical Therapy in Atlanta, GA, and is the primary physical therapy provider for Atlanta Ballet. She is on faculty in the entry-level PT program at Mercer University and is an instructor for Myopain Seminars' Dry Needling courses. She can be contacted at MandyDancePT@gmail.com.

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Treating Your First Patient With a Total Ankle Replacement? Or, Have You Taken Care of a Whole Bunch?

Christopher Neville, PT, PhD

Total ankle replacement (TAR) is gaining acceptance as an alternative to ankle arthrodesis (AA). In a recent article on Medicare trends in the United States, the number of TAR cases increased by more than 1000%.[1] When normalized to population growth, the per capita increase was 670.8% compared to AA, which declined by 15.6% per capita utilization. This can be explained by the number of hospitals across the country performing TAR increasing 4-fold from 3.1% in 1991 to 12.6% in 2010 while the number performing AA remained unchanged. These trends are echoed for me with visits to our local university-based orthopaedic clinic where I have sat through a growing number of discussions between patients and orthopaedic surgeons about the pros and cons of TAR versus AA. Data from 2000-2010 estimates the utilization of ankle replacement nationwide to be 13,141 TAR cases and 80,426 AA cases with the percentage of TAR cases on a steady rise.[2] For comparison, the number of hip replacements per year is about 650,000 while knee replacements are done 720,000 times per year. Although TAR represents only a small percentage of the arthroplasty cases being performed, is our caseload of patients with TAR likely to continue to rise? This might depend on the region of the country you live in. Western states were noted to have the highest rates of open and arthroscopic fusions whereas TAR was performed most frequently in the Midwest.[3]

While physical therapy (PT) is more widely used after total knee replacement, utilization of PT following hip replacement is more varied. Techniques for both hip and knee arthroplasty have evolved to provide favorable outcomes while neither AA nor TAR have demonstrated the same. Early designs for TAR were shown to have high failure and complication rates, leading to continued use of AA as the "gold standard" for treatment of end-stage arthritis of the ankle. Though it remains the gold standard, AA is not without its own issues, including potential adjacent joint disease and significant gait inefficiencies. Continued focus on improving TAR procedures and outcomes has ultimately led to a resurgence of its use. The available long-term outcome studies for total ankle replacement found excellent or good results in 82% of patients who received a newer generation ankle device compared with 72% if undergoing ankle fusion.[4] What are the guidelines for physical therapy following ankle replacement? Literature searches on PT and ankle replacement return a dearth of articles and the few that are available are laboratory based case series focused on improvement of gait mechanics following TAR but gait asymmetries are apparent 2 years post.[5] Although interesting, this doesn't provide evidence of the role of PT in TAR. Perhaps the clinical focus on improved ankle range of motion and functional abilities using TAR over AA will highlight PT as a vital part of TAR rehabilitation. Obviously continued long-term outcome studies are needed to evaluate the effectiveness of TAR and the role of PT in the rehab of these patients. It seems quite clear, however, that TAR has become a viable option for patients suffering with ankle arthritis.

I was asked to partner with my first patient with a TAR in a local duathlon 4 years ago (he rode the bike while I completed the run for our team) and at the time, TAR was a rare procedure in the local community. As we get towards the end of 2016, it seems that TAR is now more common. Physical therapy can target the range of motion and strength gains needed to improve function and return patients following TAR to active lifestyles. Perhaps you are already seeing patients post-TAR and are having success with strength gains, or maybe, more paitents post-TAR are on the way!

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IMAGING

SPECIAL INTEREST GROUP

HOUSE OF DELEGATES PASSES RC 12-16

Just prior to NEXT in Nashville in June, RC 12-16 was passed by the APTA House of Delegates with a 93% favorable vote for APTA to pursue practice authority for imaging as part of physical therapist practice. As a result, the APTA is now charged with addressing regulatory, institutional, and payment issues in physical therapist practice as our landscape of clinical practice continues to evolve.

CSM 2017 PRECONFERENCE COURSE

On Wednesday, February 15, 2017, a preconference course focused on ultrasound imaging will be offered by Doug White and Scott Epsley. *"Musculoskeletal Sonography for Common Orthopaedic and Sports Conditions"* will consist of a one-day course integrating ultrasound imaging into daily physical therapist practice. This course will present the application of musculoskeletal sonography for common conditions managed by physical therapists such as the rotator cuff, hip instability, bone stress injury, tendinopathies, and myopathies. The course will provide an overview of the physics of sonography. Techniques of imaging the extremities and trunk will be presented. Identification of normal anatomy and abnormal morphology will be presented. The use of ultrasound guided dry needling will be demonstrated. Please register early for this course as APTA bases their decision to provide these courses on the number of registrants by a particular deadline. If you want to participate, please register as early as possible to assure the course will take place. By attending, you are also providing support for the Imaging SIG.

CSM PROGRAMMING

Other Imaging SIG programming during the main CSM 2017 includes *"Imaging in Physical Therapy…from Classroom to Clinical Practice"* addresses introductory imaging education in physical therapist curricula through various educational institution models bridging through clinical experiences and then to the practice setting as licensed physical therapists. With imaging content now being specifically required by CAPTE, the session will feature an interactive exchange among participants and presenters, discussing the challenges and successes of incorporating imaging into physical therapy education curricula. Presenters include Jim Elliott, Bob Boyles, Becky Rodda, Brian Young, Bill Boissonnault, and Chuck Hazle.

EDUCATION LEADERSHIP CONFERENCE 2016

In early October 2016, the Imaging SIG will have a presence at the Education Leadership Conference in Phoenix. Educators will be advised in constructing and refining imaging curricular content through multiple models of institutional settings. Other important resources such as the *"Imaging Educational Manual"* and the recently published *"Diagnostic and Procedural Imaging in Physical Therapist Practice"* will be discussed along with the resources available for successfully including imaging into the clinical reasoning content of the curriculum. Presenters include Aimee Klein, Brian Young, Bob Boyles, and Chuck Hazle.

THE IMAGING SPECIAL INTEREST GROUP ON FACEBOOK & TWITTER

A reminder of our presence on social media with Facebook and Twitter. The Facebook page is available only to members and can be accessed at https://www.facebook. com/groups/1534624566841610/. Then, click "Join Group." Once your Imaging SIG membership is verified, you will be added to this private Facebook page. Additionally, our Twitter handle is @PTImgSIG; please follow and contribute with posts directly related to imaging.

Nominating Committee Member Election

The Imaging SIG will be electing an individual to fill one position for a 3-year term on the Nominating Committee this fall. Please watch for e-mail correspondence and check the Imaging SIG web page for additional information.

LEADERSHIP

Charles Hazle, PT, PhD – President
James (Jim) Elliot, PhD, PT – Vice President
Nominating Committee
Marcie Harris Hayes, PT, DPT, MSCI, OCS, Chair
Nancy Talbott, PhD, MS, PT
Paul Beattie, PT, PhD, OCS, FAPTA
George Beneck, PT, PhD – Research Committee Chair
Joel Fallano, PT, DPT, MS, OCS – Publications Editor
Aimee Klein, PT, DPT, DSc, OCS – Orthopaedic Section Board Liaison

SPECIAL INTEREST GROUP

President's Message

Kirk Peck, PT, PhD, CSCS, CCRT, CERP

APTA COMBINED SECTIONS

As noted in my last address, I again highly encourage all of you to attend the 2017 APTA Combined Sections Meeting in San Antonio, February 15-18. The topic for the ARSIG programming will be on manual therapy for the canine cervical spine presented by Ria Acciani MPT, and David Acciani PT. This will no doubt be an excellent educational opportunity so please come and support the SIG, both at the programming session and during the Business Meeting scheduled immediately beforehand.

PRACTICE ANALYSIS UPDATE

The ARSIG Practice Analysis survey is undergoing final preparations before an official launch to all SIG members. The end product is a survey tool that will require approximately 60 to 90 minutes to adequately complete, but the data will be incredibly vital to future SIG planning. Therefore, it will be important for everyone to complete the survey once received. The goal is to finalize the survey in electronic format sometime this fall.

CALIFORNIA VETERINARY MEDICAL BOARD

The California Animal Rehab Task Force continues to move forward with meetings and negotiations. As noted in the prior President's Message, a Gofundme campaign has been organized to support the efforts of the task force. If you wish to donate to the fund, you may do so at the following link: https://www.gofundme.com/mqzmtu3g. Please watch the "must see" video also posted on the website to gain a greater appreciation for physical therapists treating neurologic canine conditions.

IF I HAD A CRYSTAL BALL

I wish I could predict the future of animal rehabilitation in the United States, and globally for that matter. I can only speculate on what has the potential to become a significant and most gratifying niche practice for the profession of physical therapy if only a greater number of physical therapists would expand their skill set and enter the field.

Over the past few years there has been an increased number of students expressing an interest in animal rehabilitation, but they all ask the same questions, *"How does one get started in animal practice, and how much income can one generate?"* My response to these questions is described below.

First, physical therapists have a professional duty to review the laws in their state of residence to determine if animal practice is even legal. This entails a thorough review both of state statutes (eg, PT Scope of Practice), in addition to PT and veterinary regulatory language pertaining to practice on animals. In most cases explicit language for PTs to practice on animals does not exist, but loopholes in some states have been identified by ARSIG legislative liaisons. Therefore, if questions arise regarding animal practice, please inquire with appropriate state licensing boards or APTA Chapter Associations for clarification.

If it is legal for physical therapists to practice, then the next step is for the therapist to acquire appropriate educational competencies in either canine or equine rehabilitation, or both if so desired. Additional education is essentially mandatory for physical therapists so they may practice on animals with appropriate compassion, competence, and confidence to earn respect and integrity among peers and by the veterinary profession.

Second, yes, physical therapists can make a reasonable living practicing on animals as a predominately cash-based option. Physical therapists have used various models of practice including self-employment, home-based care, leasing contracts with veterinary clinics, and other collaborations for space and equipment utilization. The key to success in animal practice is to be creative and persistent.

ADDED CREDENTIALS

You may or may not have noticed that since the last edition of *OPTP*, I successfully completed a certification in equine rehabilitation through Northeast Seminars at the University of Tennessee. I thoroughly enjoyed the learning opportunity to share ideas and past experiences with new colleagues in veterinary and physical therapy practice. Historically I have only focused on canine care, but have found the world of equine rehabilitation and sport performance to be an incredible experience.

Since getting my certification, I have collaborated in equine practice with Sharon Classen, PT, CERP, who presented on elite Show Jumping athletes during CSM last January. Sharon has an immense depth of knowledge, experience, and energy. Through our valuable relationship, I have gained a greater appreciation for viewing the horse as an animal with incredible athletic ability. Witnessing immediate improvement in equine sport performance during competitive equestrian show jumping following physical therapy care is very gratifying. These experiences have also made me realize just how beneficial physical therapy interventions can be when applied to the equine client. Hopefully more physical therapists in the future will consider a career or at least a hobby working with equine clients.

CALL FOR ARTICLES

Please help; I am seeking energetic individual SIG members willing to contribute to the *OPTP* for the greater cause of animal rehabilitation. For the next edition, I am particularly interested in articles related to any of the following topics: (1) canine or equine nutrition; (2) updates on scientific evidence for any therapeutic physical agent including shock wave, laser, dry needling; or (3) unique treatment techniques or exercise options for any given pathology or physical condition. Please do not hesitate to contact me with any questions related to this special request. This is your chance to share valuable knowledge with others.

CONTRIBUTORY ACKNOWLEDGMENT

In this edition of *OPTP*, Jennifer Brooks provides an insightful case study related to a tibial nerve laceration in a German Shepherd. The outcome of the case is well worth the read.

Thanks again for submitting another fine example of skilled physical therapy care in action.

Williams Flexion Exercise "Feline Style"

Contact: Kirk Peck,
President ARSIG
Office (402) 280-5633
Email: kpeck@creighton.edu

Lacerated Tibial Nerve in a 3-year-old German Shepherd

Jennifer Brooks, PT, MEd, CERP, CCRP

Thor is a 3-year-old rescued German Shepherd (GSD) who presented with a pre-existing injury from 12 months prior. Thor had stepped on a broken bottle and lacerated the left Tibial nerve causing secondary injury to the left hind (LH) leg and paw. The nerve damage caused Thor to walk on the rear aspect of his paw (primarily on the metatarsal pad) instead of the digits. In turn, an adapted "flat footed" stance developed during weight bearing causing a secondary abrasion that led to a chronic open wound on the metatarsal pad. On the day of evaluation, Thor off-loaded the LH leg in stance, but applied weight with walk and run gaits. Thor's veterinarian suggested a trial of aquatics and laser for wound healing.

HISTORY

Findings on initial evaluation: Past Medical History; unknown since Thor was a rescue dog. The owner had only adopted Thor 2 months prior to bringing him to the physical therapy visit. Home setting: Thor lives with a married couple and another dog, walks twice-daily on leash for 50 minutes, and regularly plays ball with his owner. He navigates a full flight of carpeted stairs. Thor is allowed free range of the house during the day and is crated at night. He is independent in and out of car. Medications: gabapentin, Keflex, carprofen.

PHYSICAL THERAPY EVALUATION FINDINGS

Intermittent weight bearing on LH limb in standing. Sits square but LH digits elevate off the surface. Digits lack full flexion mobility. Independent with all positional changes. Lame at walk 1/4, lame at trot 2/4. No knuckling of left digits during gait. Wound on plantar surface of metatarsal pad, 2cm x 2cm (approximately dime size), depth 1-2 mm (see Figure 1).

Figure 1. Wound at initial evaluation.

Girth Measurements:	R hind	L hind
Hips	57 cm	50 cm
Stifles	26 cm	24 cm

Thor has aggressive tendencies making it difficult to assess sensory responses. Finger placement in web-space elicited a gross motor response with limb withdrawal but no curling of digits. Suspect Thor has paralysis of LH digital flexors contributing to altered weight-bearing mechanics with pressures placed on LH metatarsal pad causing secondary tissue breakdown.

TREATMENT RECOMMENDATION

Regular physical therapy visits for owner instruction of proper wound care 2x day, daily laser application to promote tissue healing, regain functional use of LH by restoring flexibility, range of motion, and strengthening exercises over the next 6 to 10 weeks.

Prognosis: Fair to Good.

PROBLEM LIST

Aggressive behavior issues, long nails, muscle atrophy and weakness of LH, compensatory posturing, suspected lack of active digit flexion, decreased overall mobility, lameness of gait patterns, open wound, and questionable pain in wound bed.

PHYSICAL THERAPY GOALS

Trim nails for proper break-over of limb, maintain or restore digit and tarsus (hock) mobility, owner education of wound and bandaging, exercise restrictions, wound management, strengthen LH proximal musculature, restore proper posture and weight-bearing tolerance to LH, restore normal gait, and reduce pain. Owner states, *"I want to heal the pad, and see if we can get him to walk better on toes, and strengthen the leg and use it more."*

PHYSICAL THERAPY TREATMENT REGIME

1. Client education on improving Thor's behavior and anxiety.
2. Instruction of proper wound care, cleaning, and bandaging to be changed twice daily, laser therapy, followed by application of Neosporin prior to bandaging, covered by a bootie.
3. Instruction in modified activity. Owner had dog running after balls, and 50 minutes of walking and swimming. Encouraged owner to do lower force activities, such as shorter (15 min) more frequent leash walks, to allow better wound healing.
4. Owner stated that dog *"did not go after the foot"* so we agreed he could let the dog have the foot unbandaged at night, only when crated, to allow air exposure to assist in healing process.
5. Owner applied laser following instruction: 2x/day for first week, followed by 1x/daily for the remaining month. Dose of 4-6 joules/cm2 to affected wound area, in non-contact wand-sweeping method, starting at proximal inquinal area to address lymphatics, prior to distal limb wound.

SIX-WEEK PHYSICAL THERAPY TREATMENT SCHEDULE

1. Underwater treadmill: 7 minutes first session; add 5 minutes/session; goal of 25 minutes.
2. Laser and re-bandage wound.
3. Range of motion to left hock and digits.

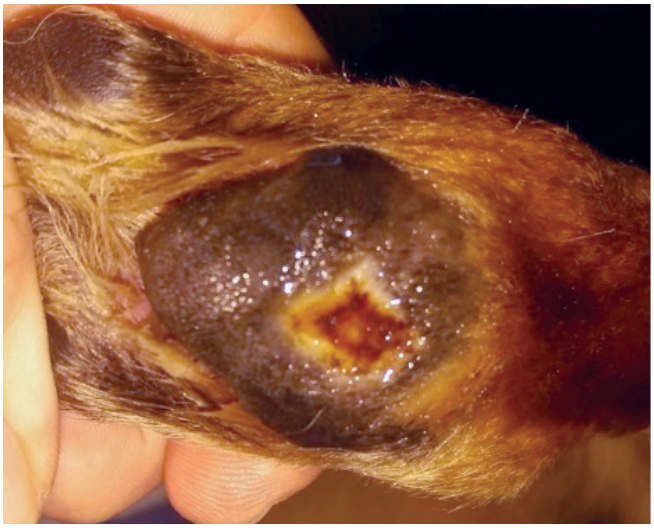


Figure 2. Wound at week 2.

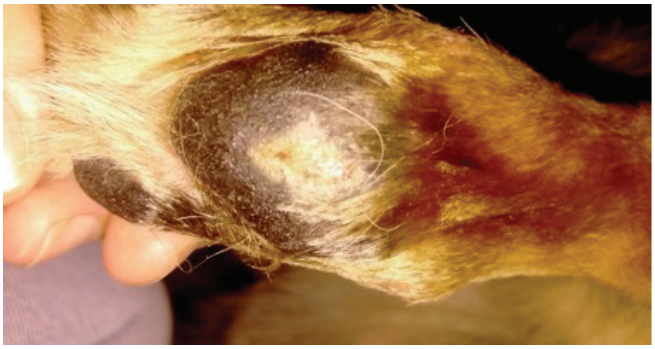


Figure 3. Wound at week 3.

Figure 4. Wound at week 4.

Figure 5. Wound at week 5.

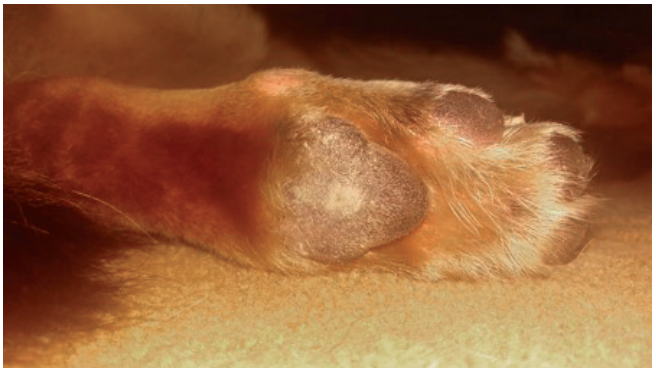
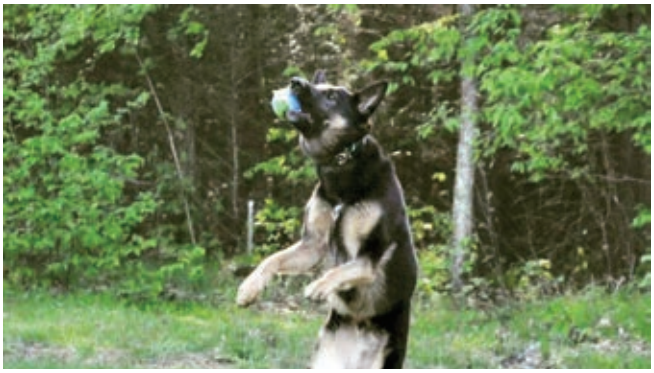


Figure 6. Wound at week 6.



Thor at discharge.

4. Home program to strengthen involved limb. Weight shifting to LH; sit to stands; cavalettes, wobble board, and therapy ball core exercises.

OUTCOME

Thor had total of 7 PT sessions over a 6-week period. By the end of week 3, Thor was standing on LH and able to lift RH to urinate. As per weekly photo progression (Figures 2-6), Thor's wound healed well, along with a reduction in lameness. Thor was discharged and returned to normal functional activities with respect of left metatarsal pad vulnerability. At discharge, Thor had gained 5 cm of thigh girth leaving a 2 cm deficit from non-affected limb.

Owner's comments on the animal physical therapy experience: *"Thor's behavior and comfort level improved by leaps and bounds during this time. After just a few treadmill sessions, Thor began to stand on all 4 legs. The positive changes I saw in Thor's wound and the strengthening of his hind leg was incredible. I am a believer that the laser treatment was a big reason why the wound closed so quickly. I have to admit it was challenging for me to undertake all the care that Thor required. I would not have been able to do it without the support and the instruction from the PT team."*

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