The Use of Manual Physical Therapy in the Treatment of Sacroiliitis: A Case Report

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The use of manual physical therapy in the treatment of sacroiliitis: a case report

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Gary Mott, PT Date

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Abstract

Introduction: Sacroiliitis is a pelvic dysfunction that can cause symptoms in both the low back and hip as well as occasionally radiating into the lower extremity. Treatment options include core strengthening and stretching exercises as well as manual therapy techniques involving mobilizations of the pelvis and sacrum and soft tissue mobilizations of the adjacent muscles. The purpose of this case report is to demonstrate the effect of applying manual therapy techniques directed at the soft-tissue of the sacroiliac joint in conjunction with therapeutic exercise. **Case Description:** A 42 year old female was referred for left hip and low back pain. She previously received 28 sessions of physical therapy consisting of core stabilization exercises but needed to return to physical therapy 2 months later due to lingering pain and decreased function. Static pelvic assessment revealed impairments in sacral position and mobility. She received 12 sessions of physical therapy over a 4-week period. The plan of care included core strengthening exercises and manual therapy techniques to the pelvis, sacrum and hip. Manual therapy techniques consisted of muscle energy, mobilizations, strain-counterstrain, and transverse friction massage. **Outcome:** She reported a decrease in pain rating of 6/10 to 2/10 on a 0-10 visual analog scale (VAS) and improvement in function as noted by a Roland-Morris score of 7/24. **Discussion:** Manual physical therapy was beneficial for this patient in reducing her pain and improving her function as noted by significant change in the VAS and the Roland Morris scores. Further study focusing on each individual technique is needed to determine the effectiveness of the interventions in order to ensure the most effective plan of care.

Keywords: sacroiliitis, mobilization, manual therapy, physical therapy, diagnosis, treatment, pelvis, ilium, sacrum, sacroiliac, iliosacral

Introduction

Sacroiliitis is a problem commonly seen in the physical therapy clinic; various reports place the frequency anywhere from to 10% to 30% of patients reporting low back pain (LBP).[1,2,3,4,5,6] The prevalence of LBP is very high with reports of 70%-85% of all people with a high rate of recurrence.[3,6,7,8,9] This places a large economic burden on the healthcare system,[7,8,10] with reports of a suspected cost ranging from 84 billion to 625 billion dollars per year.[10]

In order to effectively treat the sacroiliac region it is necessary to understand the anatomy, physiology, and kinematics of the sacrum and the pelvis. The sacrum is composed of 5 fused vertebral segments and articulates with the pelvis to form the sacroiliac joint. The pelvis consists of 2 halves, each of which is composed of three parts, the pubis, the ischium, and the ilium. The ilium is the portion of the pelvis which articulates with the sacrum to form the sacroiliac joint. The anterior third of the sacroiliac articulation is a synovial joint while the remaining dorsal component is entirely ligamentous.[5,11] During normal motion and respiration the sacrum can move along 3 axes: transverse, left oblique, and right oblique.[5,6,11] Sacroiliac or iliosacral dysfunctions can occur when the sacrum or ilium becomes stuck in one position. Dysfunctions at this articulation can occur at the pelvis and/or sacrum and include: superior or inferior innominate shears (upslip or downslip), anterior or posterior innominate rotation, anterior or posterior sacral torsions.[11,12,13,14]

An innominate shear is identified through palpation of bony landmarks where the anterior superior iliac spine (ASIS), posterior superior iliac spine (PSIS), pubic height and iliac crest height are not symmetrical. A superior shear (upslip) will present with all 4 landmarks elevated in comparison to the contralateral side while an inferior shear (downslip)

will present with the exact opposite findings.[13] A posterior innominate rotation will present with an inferior PSIS and superior ASIS in comparison to the contralateral side[12,13] while an anterior rotation will present with the exact opposite findings.[6,13,14] A sacral torsion dysfunction occurs when the sacrum tilts anteriorly or posteriorly around an oblique axis and will present with one side of the sacral base oriented anteriorly and the contralateral inferior lateral angle (ILA) oriented posteriorly.[11,12,13] For example, an anterior torsion along the left oblique axis will present with the right side of the sacral base oriented anteriorly (deep) and the left ILA oriented posteriorly.

There are several muscles which attach to the pelvis and sacrum which will affect the sacroiliac joint. These structures include the piriformis, hamstrings, gluteus maximus, quadratus lumborum (QL), erector spinae, iliacus, and latissimus dorsi (LD).[15,16] The piriformis attaches from the anterior surface of the sacrum to the greater trochanter of the femur and it acts to externally rotates the hip.[16] The hamstrings attach from the ischial tuberosity to the fibular head and it causes, flexion the knee or extension of the hip.[16] The QL attaches from 12th rib and lumbar spine to the iliac crest and laterally flexes the spine.[16] The LD attaches from the iliac crest to the lesser tubercle of the humerus and it extends, adducts, and internally rotates the arm.[16] Due to the attachment and actions of these muscles an imbalance could lead to a sacroiliac joint dysfunction.[11,15,17]

Different approaches to the diagnosis of sacroiliitis include sacroiliac injection, medical imaging, and clinical tests. Medical imaging has been reported to be ineffective in determining the diagnosis of sacroilitis.[3,4,11,18] Sacroiliac joint injection has been shown to be moderately effective and is considered to be the gold standard to confirm the presence of sacroiliitis.[2,3,4,5,6,11,15,18,19] The reliability and validity of clinical testing with sacroiliitis is

variable. Overall, most research efforts have concluded that the commonly used palpatory and positional tests are ineffective at diagnosing sacroiliitis due to poor reliability and validity.[15,20,21,22,23,24,25] In contrast, pain provocation tests appear to have a higher level of reliability.[2,15,21,26]

There are many clinical tests that have been used historically to identify sacroiliitis. Tests can be done static or dynamic. Static tests include sacral compression, Gaenslen, sacral thrust, thigh thrust, sacral distraction, and FABER.[18,19,26] The sacral compression test is performed with the patient in a sidelying position while the examiner delivers a compressive force through the iliac crest. The test is positive if sacroiliac pain is generated.[27] Gaenslen's test is performed with the patient positioned supine while one hip is maximally flexed and the contralateral hip is maximally extended. The test is positive if sacroiliac pain is generated.[18] The sacral thrust test is performed with the patient lying prone while the examiner applies a posterior to anterior force on the sacrum. The test is positive if sacroiliac pain is generated.[12] The thigh thrust test positions the patient in supine with their hip and knee at 90 degrees of flexion while the examiner applies axial force along the femur. The test is positive if sacroiliac pain is generated.[20] Sacral distraction testing involves positioning the patient supine with the examiner standing to the side of and looking down at the patient. The examiner crosses their arms and pushes posteriorly and laterally on each ASIS. The test is positive if sacroiliac pain is generated.[27] FABER's test is performed with the patient lying supine while the examiner places the lateral portion of the patient's foot on the opposite knee. The examiner provides gentle force at the patient's knee, moving the flexed lower extremity into abduction and external rotation while stabilizing the opposite ASIS. The test is positive if sacroiliac pain is generated.[28]

Dynamic testing for sacroiliitis include the Gillet test, seated flexion test, long sitting test, and the active straight leg raise (ASLR) test. The Gillet test is performed with the patient standing while examiner stands behind the patient palpating the area directly under PSIS and the Sacral 2 tubercle simultaneously. The patient stands on one leg while flexing the contralateral hip and knee toward their chest. The test is positive if the PSIS does not move caudally.[24] A seated flexion test involves instructing the patient to flex their trunk forward, between the legs, while keeping the knees flexed and feet flat on the floor. The examiner sits behind the patient and palpates the area just caudal the both PSISs. The test is positive on one side if the PSIS moves more superiorly than the contralateral side.[24] The long sitting test starts with the patient in the supine position while the examiner places their thumbs on the inferior borders of the patient's bilateral medial malleoli. The patient is then instructed to sit-up into a long sitting position. The test is positive if one leg appears to lengthen in comparison to the other. [24,29] An ASLR test involves having the patient lie supine and attempt to raise their leg 20 cm without bending the knee. Pain or poor motor control during ASLR is a positive test result for SI joint dysfunction.[30]

Some research efforts have shown that clusters of tests have the highest levels of reliability.[18,26,29] Laslett et al[19] analyzed 6 special tests and proposed using a cluster of these for the differential diagnosis of sacroiliitis. Their results showed increasing levels of specificity with the addition of each special test. Refer to Table 2: Sensitivity, Specificity, and Predictive Values of Special Tests for Sacroiliac Pain. This study also showed a positive likelihood ratio of 4.29 with the use of three of the six special tests. This was supported in a later systematic review by Stuber[26] which noted that the study by Laslett et al was the highest quality of all the literature that was reviewed.

One common approach to treat sacroiliac dysfunction is a core strengthening program for the pelvic, low back, and abdominal muscles.[18,31,32,33,34] Core strengthening emphasizes control and strength of the abdominal and back muscles. A systematic review by Standaert et al[31] noted that the literature shows evidence that stabilization exercises, performed with activation of the transverse abdominus and multifidi, are effective at improving pain and function in persons with chronic low back pain. Slipman et al[15] also proposed using physical therapy strategies emphasizing pelvic stabilization in order to address the tightening and weakness of the core musculature that is often present in patients with low back dysfunction.

Manual therapy has also been used to treat sacroiliac dysfunction. Manual therapy techniques are used by several types of healthcare practitioners including chiropractors, osteopathic physicians, and physical therapists.[7,11,18,35,36,37] A manual therapist employs techniques by hands on application of forces. Through the use of these forces, a clinician attempts to cause a release of the fascia, compression, traction, stretching, mobilization, and/or manipulation.[7,38]

Mobilization/manipulation is defined by *The Guide to Physical Therapist Practice* (*The Guide*) as a manual therapy technique comprising a continuum of skilled passive movements to the joints and/or related soft tissues that are applied at varying speeds and amplitudes, including a small-amplitude/high-velocity therapeutic movement.[39] While some research has demonstrated that high velocity low amplitude manipulations does not alter the position of the components of the sacroiliac joint, [35] other evidence has shown some effect occurs resulting in improvements in patients' impairments.[12,17,36,37,38,40,41,42] The effectiveness of manipulations may be due to the nature of the synovial joint. The articular cartilage of the synovial joint requires regular loading and unloading to remain healthy and

hydrated via movement of synovial fluid over its surface, as well as pumping it in and out of the articular cartilage.[43,44,45] Studies have shown that mobilization and manipulation of the spine and pelvis can inhibit the surrounding musculature and thereby reducing pain and improving mobility.[5,14,17,41,46] Dysfunction of the muscles attached to the low back and pelvis have been shown to influence mobility and function. Correcting these musculature dysfunctions could improve mobility, function and pain.[11,15,17]

Muscle energy techniques (MET), strain counterstrain (SCS), and transverse friction massage (TFM) are forms of manual therapy used by healthcare practitioners. The concept of MET, first proposed by Mitchell, involves the use of therapist prompted muscular activation by the patient.[13] A principle of MET employs the activation of the golgi tendon reflex and can be applied directly or in-directly through the use of reciprocal inhibition or post isometric relaxation respectively.[13,47] Reciprocal inhibition causes an antagonist relaxation through the activation of an agonist muscle contraction,[48] while post isometric relaxation causes fatigue via a refractory period leading to a greater ability to stretch the agonist.[47,49,50] During a MET treatment, the therapist places the articular surfaces to be affected in the loose packed position; three dimensional position of least joint restriction and most joint play. The loose pack position is found by moving the structure to be treated into a range of palpable restriction to movement and backing off slightly. The location that is achieved at this point is the treatment barrier.[13,51] Once the structure is positioned in the treatment barrier the patient is instructed to contract the muscle while the therapist resists, creating an isometric contraction. The hold time of the isometric contraction varies, in the literature, with some sources noting 3-5 seconds[52,53] while some advocate as much as 7-10 seconds.[54] The number of repetitions to be performed varies, with some sources stating to

repeat as long as a restriction to movement is palpated[13] and other sources advocating 5 repetitions.[53,55]

The concept of SCS, first proposed by Jones, involves the movement of the structure to be treated into a shortened position (i.e. moving the muscle's insertion closer to the origin). The intended result is a decrease or elimination of the mechanical stimulation allowing a reduction in the excitation of the gamma motor neuron which in turn should decrease the resting or relaxed-state tension of the structure. This occurs through a neurological reflex loop involving the alpha motor neuron, gamma motor neuron, and the muscle spindle.[56]

Transverse friction massage (TFM) or deep transverse massage was developed by Cyriax. It involves the use of a rhythmic force, applied by the therapist, perpendicular to the fibers of the dysfunctional tissue.[57] The intended result is to break abnormally oriented fibers, provide a rapid analgesic effect, and potentially increase localized blood flow resulting in an increased healing effect.[57] TFM has been used to treat soft tissue dysfunction in many different areas of the body.[58,59,60,61,62]

Standardized outcome measures are used to assess the effectiveness of physical therapy intervention in improving patient function. One such outcome measure is the Roland Morris Low Back Pain and Disability Questionnaire. The Roland Morris consists of 24 items and is scored by adding all of the patient's positive responses. The potential score ranges from 0/24 to 24/24 with a lower score indicating a higher level of function. Stratford et al[63] found that a change in score of 5 or more is the minimal clinically important difference (MCID) with a starting score of 12/24. The Fear Avoidance Beliefs Questionnaire (FABQ) is also used as a standardize outcome measure for patients with low back dysfunction. The

FABQ assesses patients' beliefs about how their low back pain affects their physical activity and consists of 16 items. The patient rates their level of agreement with each item on a 7 point scale where 0 notes complete disagreement and 6 notes complete agreement. A higher score is related to a greater degree of fear driven avoidance behavior. The FABQ has a high level of test-retest reliability overall (ICC of=0.97) with the work scale subset being a better predictor of self-reported disability (95% CI: 0.542-0.846).[64,65]

Physical therapists use the World Health Organization-International Classification of Functioning, Disability, and Health (WHO-ICF) for diagnosis/classification of a patient's impairments of body, structure and function, activities limitations and participation restrictions.[66] The WHO-ICF model was developed to describe and measure health and function through the interaction of two main components; function/disability and environment/personal factors.[66] Physical therapists treat impairments with patient education, therapeutic exercises, manual therapy to improve mechanics, and modalities. Using the WHO ICF classification, sacroiliitis affects the body structure of the pelvis and sacrum with impairments in pain, mobility of joints, and stability of joints. These impairments can cause activity restrictions including lifting, squatting, and maintaining a body position which can lead to participation restrictions at work and home.

The purpose of this case report is to demonstrate the effect of applying manual therapy techniques directed at the soft-tissue of the sacroiliac joint, in conjunction with therapeutic exercise in addressing impairments, activity limitations and participation restrictions associated with sacroiliac dysfunction.

Case Description

The patient was a 42 year old female with a chief complaint of left hip and LBP. She was injured at work while trying to prevent injury to a client. Her left hip was forced into hip flexion, external rotation, and abduction. The patient reported that she had localized pain at the left sacral sulcus and diffuse hip pain. She was unable to work secondary to pain and was unable to fully care for her husband and two young children. She received previous medical and physical therapy management. She was treated with a 5% Lidoderm patch and a previous course of physical therapy. The previous course of physical therapy included therapeutic exercise, consisting primarily of core strengthening exercises and stretching, as well as electrical stimulation for pain control. She was discharged after 28 sessions with a home exercise program and a transcutaneous electrical stimulation unit (TENS) to be used as needed and set at a frequency of 150Hz. The patient reported having made gains in mobility and strength as well as decreasing her pain from a 6/10 to a 4/10 on a 0-10 visual analog scale (VAS) where 0 equals no pain and 10 equals the most intense pain possible. The patient noted that her hip pain was 75% better but felt no relief in her back pain. Radiographs performed at that time revealed lumbar degenerative disc disease and grade 2 L5-S1 spondylolisthesis.

The patient returned to her physician because of worsening of her symptoms. She was referred to physical therapy with diagnosis of grade 2 L5-S1 spondylolisthesis and lumbar degenerative disc disease. Her injury occurred 18 weeks prior to the start of this course of physical therapy. At the time of her initial examination, she reported pain of 4 to 6/10 with declining ability to function. Her chief compliant was constant discomfort with morning stiffness and pain rated at 4/10 which increased throughout the work day to 6/10

causing decreased job performance. Her pain was localized to her left hip and low back and described as stiff with occasional bouts of sharp pain. Her pain would decrease with rest but would return in the morning upon waking. She also noted popping in her hips bilaterally with quick and/or rotational movements occurring during housework and work activities. The patient noted activity restrictions of squatting, prolonged standing/walking, and lifting which resulted in participation restrictions of being unable to fully care for her family, to work, perform housework, or drive.

The patient presented with normal range of motion (ROM) in her trunk and bilateral lower extremities. Strength was also normal with the exception of hip internal and external rotation, which was each 4/5 bilaterally. The patient completed a Roland Morris Low Back Pain and Disability Questionnaire and scored a 12/24 on a 0-24 scale with 0 indicating no dysfunction. Sacral distraction test, FABER test, and hip impingement tests were all found to be positive. Refer to Table 1: Examination Findings: Initial and Discharge.

Palpation revealed tenderness of the left sacral sulcus, right sacrotuberous ligament, and bilateral piriformi with right piriformis tension. Palpation also revealed that the sacral sulcus was deep on the right with the left sacral inferior lateral angle posterior indicating a left on left forward sacral torsion. Further palpation revealed that her left iliac crest was higher than the right. She presented with a lower left anterior superior iliac spine (ASIS) and a higher posterior superior iliac spine (PSIS) indicating an anterior rotation of the left innominate.

A hip impingement test was performed due to the patient's report of "popping in my hip", pain, and mechanism of injury. A positive hip impingement test was noted on the left. This test is performed with the patient supine with the hip and knee at 90° of flexion. The

hip is internally rotated while an adduction force is applied. A positive test results in pain provocation in the anterolateral hip or groin which could indicate a labral tear.[67,68] The reliability of hip impingement test was shown to have a Kappa coefficient of 0.58 (95% CI: 0.29-0.87).[68] Based on the positive hip impingement a hip labral tear was suspected. The patient was referred back to her physician with written correspondence suggesting a magnetic resonance image (MRI) be obtained. The resulting MRI indicated the presence of a hip labral tear.

Evaluation

The patient presented with a cluster of findings consistent with sacroiliitis. Positive findings for the FABER and sacral distraction tests indicated sacroiliitis as did the presence of tenderness at the sacral sulcus. Laslett et al[19] noted specificity and positive predictive values of 81% for the sacral distraction test in regard to sacroiliitis. Broadhurst and Bond[69] noted a specificity of 100% for the FABER test in regard to sacroiliitis. Dreyfuss et al[44] noted a sensitivity of 95% for sacral sulcus tenderness in regard to sacroiliitis. Laslett et al[19] also noted that with 3 or more tests for sacroiliitis the specificity was 78%, the sensitivity was 94%, the positive predictive value was 68%, and the negative predictive value was 96%. Refer to Table 2: Sensitivity, Specificity, and Predictive Values of Special Tests for Sacroiliac Pain.

According to *The Guide*, the cluster of signs and symptoms indicate the diagnostic/classification system for this patient was Musculoskeletal Practice Pattern 4D: Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated With Connective Tissue Dysfunction. Based on the initial examination, the factors influencing the patient's low back and hip pain were categorized, using the WHO-ICF

model. The body structures of the pelvis and sacrum were affected with impairments in pain, mobility of joints, and stability of joints. These impairments caused activity restrictions including lifting, squatting, and maintaining a body position which led to participation restrictions at work and home. The rationale used was that malalignment of the pelvis and sacrum resulted in pain as well as weakness of the hip rotators, causing limitations in the activities of lifting, squatting, and prolonged standing/walking. Difficulties with these activities were hypothesized to negatively affect her participation in employment and family care activities of assisting others (children) with self-care.

Intervention

The patient's plan of care consisted of manual therapy techniques combined with exercise based intervention 3 times a week over 4 weeks. In addition, the patient was instructed to resume her home exercise plan (HEP) consisting of posterior pelvic tilts, prone knee flexion, prone hip internal and external rotation, and piriformis stretching. She was instructed to perform these exercises in the pain free range for 20 repetitions, twice daily. She was also instructed to stretch her piriformis muscles for a 20 second hold repeating 5 times on each side. METs were used to correct the sacral and pelvic dysfunctions. Additionally, the plan of care included SCS to decrease right piriformis muscle tension. This was performed to prevent the piriformis from causing the sacrum to return to an abnormal position, leading to a resumption of sacroiliac dysfunction. Lastly, transverse friction massage of the right sacrotuberous ligament was performed with the theory that dysfunction of this structure could be the cause of its tenderness and contributing to the left sacral torsion and resulting sacroiliitis. Prior to each subsequent physical therapy session, pelvic and sacral

static alignment were reassessed. Her home exercise program was reassessed and modified based on patient's performance.

The following section outlines the interventions for each treatment session. Additional information on the interventions session can be found in Table 3: Treatment Progression.

Week 1

Session 1

The focus was on correcting the anterior innominate using MET. Therapist generated resistance was applied against a patient generated hip extension force in order to obtain an isometric contraction of the hip extensors. The following post-isometric relaxation of the muscles could potentially allow a further stretching of the muscles thereby increasing movement of the pelvis into posterior rotation. Therapist instruction to the patient to lie supine on a treatment plinth was followed by palpation of her sacral sulcus with one hand while providing support under her distal, posterior thigh using the other hand. Her thigh was passively elevated, with her lower leg relaxed, while therapist assessed the treatment barrier. Once the treatment barrier was met, the patient was instructed to gently push her left lower extremity into extension by pushing into the therapist's hand, in order to create an isometric contraction of the hamstrings. The patient was instructed to hold the contraction for 6 seconds and verbal cueing was provided. This procedure was repeated 4 more times in succession with a larger degree of elevation (increased posterior rotation of the innominate) each time. Five repetitions were performed as a palpable treatment barrier was detected prior to each isometric contraction, before reaching end range of hip flexion motion. The

intervention was followed by another static pelvic alignment assessment which revealed that the relative heights of the ASIS and PSIS were equal.

Session 2

SCS for the right piriformis was introduced. The patient was directed to lie in the prone position on top of the treatment plinth with the therapist positioned at her right side while palpating the piriformis with the right hand in order to locate the tender point. Therapist right hand position was maintained as the patient's right lower extremity was passively moved into a position of hip flexion, abduction, and external rotation, while maintaining knee flexion with the leg hanging off the plinth. The left arm of the therapist was placed between the plinth and the anterior surface of the patient's leg with the upper arm on her tibia and the hand on her anteromedial thigh. This is the standard position used to apply a strain counterstrain intervention for the piriformis.[56] This position was held while maintaining contact with the right piriformis for approximately one minute at which point muscular relaxation was palpated. Once the piriformis began to relax, increased pressure was applied with the therapist's right hand. A positive response to SCS is a decrease in pain with palpation and decrease in muscle tension. Following the first repetition of SCS the patient noted decreased tenderness compared to earlier palpation. This position was held for 1 more minute before passively returning her right lower extremity to its starting location. Constant right handed contact with the patient's piriformis was maintained throughout the SCS technique. She noted a further decrease in her tenderness to palpation following the second minute of SCS application.

Session 3

The use of TFM to the patient's right sacrotuberous ligament in the prone position was added in this session. A therapist applied gentle to moderate posterior to anterior (PA) force in a rhythmic medial-lateral direction, angulated to ensure transverse orientation along the sacrotuberous ligament for one minute. The patient reported a slight tenderness during the first 1 minute application. The TFM procedure was repeated 3 times allowing time for patient and therapist rest between each application. The session was terminated at that point with instructions to the patient to perform her home exercise plan later and use her TENS with ice as needed.

Week 2

During the second week of therapy sacral mobilizations were initiated. Static assessment performed at the beginning of each session revealed improvement in ASIS and PSIS positions; however there was no change in sacral position. In addition, the FABER and sacral distraction tests continued to be positive despite the patient's subjective report of decreasing pain, now reported at 4/10. There was a gradual improvement in sacral position and a decrease in the patient's subjective report pain over the course of sessions 4-6.

Session 4

Grade III PA sustained sacral mobilization was performed on the left ILA and was augmented through patient respiration via inhalation concurrent with the PA force at the left ILA. The PA force was held for 3 seconds with a 3 second rest period between each mobilization to allow the patient to be able to breathe comfortably and repeated over a 2 minute period.

Session 5

Seated active hip internal rotation on the right was introduced in an attempt to directly relax the piriformis. Therapist cueing and a stabilizer between the patient's knees were used during hip rotation exercises to prevent any motion into hip adduction in order to prevent hip impingement which seemed probable given the patient's labral tear.

Session 6

Seated active hip external rotation on the left was introduced in an attempt to indirectly relax the right piriformis. Therapist cueing and a stabilizer between the patient's knees were used during hip rotation exercises to prevent any motion into hip adduction in order to prevent hip impingement which seemed probable given the patient's labral tear.

Week 3

At the start of the third week of therapy static assessment, done at the start of each session, revealed a gradually improving position of the right sacral base and left ILA as well as gradual improvements in the proper positions of the ASIS and PSIS bilaterally. The patient reported decreasing intensity of pain but noted pain still intensified by the end of her day. At this point the ipsilateral ASIS and PSIS heights were equal, however the left side iliac crest, ASIS, and PSIS all continued to present in an elevated position relative to the right. These findings appeared to be consistent with a pelvic upslip[13,70] which can be treated via a hip thrust technique where a clinician will rapidly pull the leg of the dysfunctional side caudally in a long axis direction.[14,52,70] Given the possibility that this patient may have had a left hip labral tear, this technique was not used. Instead, the upslip was treated indirectly through the use of strain counter strain technique to the left latissimus dorsi (LD) and MET combined with manual stretching to the left quadratus lumborum (QL). Since the LD and

QL both attach to the ilium from a cranially located point, decreasing the tension in these muscles could result in a return to a normative position and decrease sacroiliac joint pain.

Session 7:

SCS was performed on the left LD. The patient was instructed to lie supine with the left side of her body at the edge of the plinth so that her left upper extremity would fall off the bed unless supported. While seated at her left side, the therapist passively moved the patient's left upper extremity into a relaxed position of shoulder extension, adduction, and internal rotation. This position was held for approximately 2 minutes until a sensation of total muscular relaxation was felt.

Session 8:

MET combined with manual stretching on the QL was added. The patient was instructed to lie prone with the therapist standing at her right side. The therapist's hands were placed so that the right hand was on the lower left 4 ribs posteriorly and the left hand was on the patient's left ASIS. Gentle anterior to posterior (AP) force was applied to the ASIS with a stabilizing PA force to the patient's posterior ribs in order to stretch the QL. It was stretched to the point of moderate resistance and held for approximately 10 seconds. After that period the patient was instructed to gently push her ASIS anteriorly. The patient was instructed to maintain this force for 6 seconds and then completely relax. This procedure was repeated 2 more times with an increasing translation posteriorly of the left innominate as the QL relaxed. Following this intervention pelvic position was reassessed. Palpation revealed equal heights of the iliac crests and a minimal anterior rotation of the left innominate.

Session 9:

MET correction of the left anterior innominate was performed. Therapist generated resistance was applied against a patient generated hip extension force in order to obtain an isometric contraction of the hip extensors. The post-isometric relaxation of the muscles could potentially allow a further stretching of the muscles thereby increasing movement of the pelvis into posterior rotation. Therapist instruction to the patient to lie supine on a treatment plinth was followed by palpation of her sacral sulcus with one hand while providing support under her distal, posterior thigh using the other hand. Her thigh was passively elevated, with her lower leg relaxed, while palpating the treatment barrier. Once the treatment barrier was found, the patient was instructed to gently push her left lower extremity into therapist resisted left hip extension, in order to create an isometric contraction of the hamstrings. The patient was instructed to hold the contraction for 6 seconds with the help of verbal cueing. This procedure was repeated 4 more times in succession with a larger degree of elevation (increased posterior rotation of the innominate) each time. Five repetitions were performed, reaching the palpable treatment barrier prior to each isometric contraction. This intervention was followed by another pelvic alignment assessment which revealed that the relative equal heights of the ASIS and PSIS bilaterally.

Week 4

Session 10

Left sacral torsion and right piriformis tension were still present. These were addressed using sustained sacral PA mobilization at the left ILA as described earlier in this case report.

Session 11

Left sacral torsion and right piriformis tension were still present. These were addressed using sustained sacral PA mobilization at the left ILA and SCS to the right piriformis as described earlier in this case report.

Session 12:

Left sacral torsion and right piriformis tension were still present. These were addressed using sustained sacral PA mobilization at the left ILA as described earlier in this case report. There was no further change in the left sacral torsion and right piriformis tension during this week and physical therapy was discontinued.

Outcomes

At the end of her 4th week of physical therapy intervention, the patient reported a decrease in her pain from a 6/10 to 2/10. The patient also had an improvement in her hip internal and external rotation strength now a 5/5 bilaterally. Her self-report on the Roland Morris Low Back Pain and Disability Questionnaire improved to a 7/24 (from 12/24) on a 0-24 scale, where 0 indicates normal function. The literature reports that a change in score of 5 or more is significant with a starting score of 12/24.[63] The patient also reported she was able to return to her role as the primary family caregiver due to her decreased symptoms.

Discussion

The case report demonstrated a successful treatment course of treatment for this 42 year old female with sacroiliitis using manual therapy techniques combined with a home exercise program. The patient demonstrated an improvement in all areas that were targeted including reduction in pain, increase in pelvic alignment and improved function.

This case is unique in that there were multiple body structures that could have been generating the patient's complaints of left hip and low back pain. The presence of lumbar spondylolisthesis was a potential causative factor of her low back and left hip pain[71,72] as was the labral tear of the hip.[73,74]

A thorough examination was critical in revealing the presence of sacroiliac pain and dysfunction through the presence of a cluster of special tests. Clusters of positive special tests have been shown to increase the likelihood of making a correct clinical diagnosis in comparison to individual special tests.[19,26,29] Laslett et al[19] examined 6 special tests of pain provocation; sacral distraction, thigh thrust, bilateral Gaenslen, sacral compression, and sacral thrust. They found that with the presence of 3 or more positive results, there is a positive likelihood ratio of 4.3 and a moderate shift in probability that a patient's low back, leg, and gluteal symptoms originate from sacroiliitis. Cibulka and Koldehoff[29] also examined the usefulness of using a cluster of tests to identify sacroiliac dysfunction. Their study examined 4 special tests and included dynamic testing of the sacroiliac joint; standing flexion test, seated PSIS palpation, supine long sitting test, and prone knee flexion test. They found that with the presence of at least 3 positive special tests, specificity is improved and results in an 86% positive predictive value. A cluster of 3 positive special tests were used in attempting to label the dysfunction present in this current case; sacral distraction, sacral sulcus tenderness, and FABER. These 3 tests were chosen, by this therapist, for their high levels of sensitivity and/or specificity. Refer to Table 2: Sensitivity, Specificity, and Predictive Values of Special Tests for Sacroiliac Pain. Research indicates that using a combination of static and dynamic testing is more reliable in identifying sacroiliac dysfunction.

Treatment began with a focus on correcting the anteriorly rotated left innominate. Muscle energy technique introduced through hamstrings contraction was used in an effort to correct the anteriorly rotated position of the left innominate. Cibulka et al[17] noted that all of their subjects with hamstring strains had an ipsilateral anterior pelvic tilt and further, suggested a potential change in peak torque could have been caused by a change in length of the hamstrings post manipulation of the sacroiliac joint. While this treatment focuses on the suspected left anterior rotation, there is the possibility that correction of a right posterior rotation may also have been successful. Cibulka[12] noted that as 1 innominate tilts anteriorly the ipsilateral innominate tilts posteriorly, therefore, the possibility exists that if the right posterior rotation was treated, similar results may have occurred.

During the second session, static pelvic assessment showed a maintained improvement position of ilia however the sacral malalignment persisted. Strain counter strain of the right piriformis was used in an attempt to correct the sacral torsion. This technique utilized in an effort to correct sacral malalignment without stressing the patient's hip or low back. Boyajian et al[37] noted that normal ROM and decreased pain can be achieved by decreasing piriformis spasm which is commonly managed by strain counterstrain.[37,38,75]

During the third session, TFM was used; however, due to therapist fatigue the protocol described by Cyriax[57] was not followed. The protocol calls for a 10 minute application.[57,76] The likelihood that TFM was beneficial in this case cannot be determined due to failure to administer the treatment as described. However, some literature suggests that TFM may not be beneficial despite the practical application.[77,78,79]

The patient improved during her course of physical therapy with improvements in pain report as well as the patient's subjective reports of increasing function. Given that her

treatment course was primarily composed of manual therapy to soft tissue, this researcher feels the techniques employed were likely beneficial. Despite the co-morbidities and her history of previously unsuccessful physical therapy intervention, this patient appeared to benefit from a course of manual therapy. She demonstrated increased strength and decrease in pain which allowed her to return to her role as the primary family caregiver. Her improvements in activity participation were reflected by the change her Roland Morris score.[63]

Given the challenges facing our healthcare system, physical therapists are required to achieve positive outcomes more efficiently and will therefore, need to employ all possible evaluation measures, treatment modalities, including manual therapy techniques. In addition, with the increasing focus on evidence based practice, physical therapists will need to show the functional outcomes achieved in a standardized, objective fashion. While there is some literature addressing the effectiveness of manual therapy techniques of the joints, there is limited research on soft tissue directed manual therapy techniques.

The use of manual therapy in conjunction with therapeutic exercise in this case seems to have resulted in greater improvement in impairments and function for this patient. Changes and manipulations to the joints and periarticular structures, such as ligaments and attached musculature, can cause a firing of afferent neural fibers leading to reflexive muscle relaxation and inhibition of pain receptors.[18] Murphy et al[80] proposed that joint manipulation exerts physiological effects on the central nervous system, probably at the segmental level based on their results of decreased reflex excitement of the tibial nerve following sacroiliac joint manipulation. Zelle et al[18] proposed that the therapeutic effect of manipulation is due to the stress on the ligaments and peri-articular structures which leads to the firing of afferent

neural fibers. However, there is a paucity of available research that has been undertaken to confirm, or refute, this type of intervention in comparison to joint manipulations. There is research to support the use of joint manipulation in the treatment of sacroiliac dysfunction. Research is needed in the area of manual techniques used in this case in comparison to manipulation in the treatment of sacroiliac dysfunction.

There were limitations in this case report. One limitation is in the examination of this patient which did not include dynamic testing of the sacroiliac joint. Dynamic testing is a valuable part of determining sacroiliac dysfunction. Dynamic tests that could have been included to improve the likelihood of accurately identifying sacroiliitis are the Gillet test, seated flexion test, long sitting test, and the active straight leg raise (ASLR) test. Levangie[81] reported a specificity of 93% for Gillet's test and the sitting flexion tests in patients with an innominate rotation. Another limitation in the examination process was the lack of adherence to using a cluster of 3 of the 6 special tests as described by Laslett et al.[19] While 3 positive special tests were used in this case to detect a sacroiliac dysfunction, the likelihood of correct identification could have been increased by employing different special tests. Lastly, additional patient self report functional measures could have been used, including the FABQ which has been used previously in manipulation research.[65] In this case report both manual therapy and exercised based treatments were used. The success of the patient's outcome may be attributable to either type of intervention and future research could focus on the efficacy of a manual therapy approach without exercise.

Conclusion

This case describes the management of a 42 year old female with concurrent diagnoses of sacroiliitis, hip labral tear, and lumbar spondylolisthesis. The treatment

program consisted of manual therapy and therapeutic exercise with a focus on increasing function and strength while decreasing pain. The physical therapy treatment provided improved this patient's impairments, activity limitations, and participation restrictions resulting in her return to the role of primary family caregiver. Based on the outcome of this case in comparison to her previous exercise based program, manual therapy techniques to soft tissue seem to be beneficial in the treatment of impairments related to sacroiliac dysfunction. These techniques can likely be used on other areas of the body that have a soft tissue impairments and dysfunction. More research with standardized objective outcomes is needed to examine the inter and intra-rater reliability of performing manual therapy techniques to the pelvic region. In addition, randomized clinical trials with controls are needed to compare manual and exercise based therapy in the population with soft tissue dysfunction.

References

1. Prather H, Hunt D. Sacroiliac joint pain. *Dis Mon* 2004;50:670-683.

2. Maigne JV, Aivaliklis A, Pfefer F. Results of sacroiliac joint double block and value of sacroiliac pain provocation tests in 54 patients with low back pain. *Spine* 1996;21(16):1889-1892.

3. Hansen H, McKenzie-Brown AM, Cohen S, Swicegood J, Colson J, Manchikanti L. Sacroiliac joint interventions: a systematic review. *Pain Physician* 2007;10:165-184.

4. McKenzie-Brown AM, Shah RV, Sehgal N, Everett CR. A systematic review of sacroiliac joint interventions. *Pain Physician* 2005;8:115-125.

5. Cohen SP. Sacroiliac joint pain: a comprehensive review of anatomy, diagnosis, and treatment. *Anest Analg* 2005;101:1440-1453.

6. Foley B, Buschbacher RM. Sacroiliac joint pain: anatomy, biomechanics, diagnosis, and treatment. *Am J Phys Med Rehabil* 2006;85(12):997-1006.

7. Twomey LT. A rationale for the treatment of back pain and joint pain by manual therapy. *Phys Ther* 1992;72(12):885-892.

8. Dionne CE, Korff MV, Koepsell TD, Deyo RA, Barlow WE, Checkoway H. Formal education and back pain: a review. *J Epidemiol Community Health* 2001;55:455-468.

9. Andersson G. Epidemiological feature of chronic low-back pain. *Lancet* 1999;354:581-585.

10. Dagenais DC, Caro J, Halderman S. A systematic review of low back pain cost of illness studies in the united states and internationally. *The Spine Journal* 2008;8:8-20.

11. Brolinson PG, Kozar AJ, Cibor G. Sacroiliac joint dysfunction in athletes. *Cur Sports Med Rep* 2003;2:47-56.

12. Cibulka MT. Understanding sacroiliac joint movement as a guide to the management of a patient with unilateral low back pain. *Man Ther* 2002;7(4):215-221.

13. Kuchera WA, Kuchera ML. Osteopathic Principles in Practice. Ohio, USA: Greyden Press; 1994.

14. DonTigney RL. Function and pathomechanics of the sacroiliac joint: a review. *Phys Ther*1985; 65(1): 35-44.

15. Slipman CW, Whyte WS, Chow DW, Chou L, Lenrow D, Ellen M. Sacroiliac joint syndrome. *Pain Physician* 2001;4(2):143-152.

16. Olsen TR. A.D.A.M. Student Atlas of Anatomy. Baltimore, MD: Williams & Wilkins; 1996.

17. Cibulka MT, Rose SJ, Delitto A, Sinacore DR. Hamstring muscle strain treated by mobilizing the sacroiliac joint. *Phys Ther* 1986;66(8):1220-1223.

18. Zelle BA, Gruen GS, Brown S, George S. Sacroiliac joint dysfunction: evaluation and management. *Clin J Pain* 2005;21(5):446-455.

19. Laslett M, Aprill CN, McDonald B, Young SB. Diagnosis of sacroiliac joint pain: validity of individual provocation tests and composites of tests. *Man Ther* 2005; 10:207–218.

20. Dreyfuss P, Dreyer S, Griffin J, et al. Positive sacroiliac screening tests in asymptomatic adults. *Spine* 1994;19:1138-1143.

21. Slipman CW, Sterenfeld EB, Chou LH, et al. The predictive value of provocative sacroiliac joint stress maneuvers in the diagnosis of sacroiliac joint syndrome. *Arch Phys Med Rehabil* 1998;79:288-292.

22. Van der Wurff P, Hagmeiher RH, Meyne W. Clinical tests of the sacroiliac joint: a systematic methodological review. Part I: reliability. *Man Ther* 2000;5:30-36.

23. Van der Wurff P, Hagmeiher RH, Meyne W. Clinical tests of the sacroiliac joint: a systematic methodological review. Part II: reliability. *Man Ther* 2000;5:89-96.

24. Potter N, Rothenstein JM. Intertester reliability for selected clinical tests of the sacroiliac joint. *Phys Ther* 1985;65(11):1671-1675.

25. Haneline MT, Young M. A review on intraexaminer and interexaminer reliability of static spinal palpation: a literature synthesis. *J Manipulative Physiol Ther* 2009;32(5):379-386.

26. Stuber KJ. Specificity, sensitivity, and predictive values of clinical tests of the sacroiliac joint: a systematic review of the literature. *J Can Chiropr Assoc* 2007;51(1): 30-41.

27. Schultz SJ, Houglum PA, Perrin DH. Examination of Musculoskeletal Injuries. 2nd ed. Champaign, IL; 1995.

28. Magee DJ. Orthopedic Physical Assessment. 5th ed. St. Louis, MO: Saunders Elsevier; 2008.

29. Cibulka MT, Koldehoff R. Clinical usefulness of a cluster of sacroiliac joint tests in patients with and without low back pain. *J Orthop Sports Phys Ther* 1999;29(2):83-92.

30. Liebenson C. Vleeming's active SLR test as a screen for lumbopelvic dysfunction. *Dynamic Chiropractic* 2003; 21(5): 1-5.

31. Standaert CJ, Weinstein SM, Rumpeltes J. Evidence-informed management of chronic low back pain with lumbar stabilization exercises. *The Spine Journal* 2008;8:114-120.

32. Prather H. Pelvis and sacral dysfunction in sports and exercise. *Phys Med Rehabil Clin North Am* 2000;11:805-836.

33. Prather H. Sacroiliac joint pain: practical management. *Clin J Sport Med* 2003;13:252-255.

34. Hodges PW, Richardson CA. Inefficient muscular stabilization of the lumbar spine associated with low back pain. A motor control evaluation of transverses abdominis. *Spine* 1996;21:2640-2650.

35. Tullberg T, Blomberg S, Branth B, Johnsson R. Manipulation does not alter the position of the sacroiliac joint: a roentgen stereophotogrammetric analysis. *Spine* 1998;23(10):1124-1128.

36. Bronfort G, Haas M, Evans R, Kawchuk G, Dagenais S. Evidence-informed management of chronic low back pain with spinal manipulation and mobilization. *The Spine Journal* 2008;8:213-225.

37. Boyajian-O'Neil LA, McClain RL, Coleman MK, Thomas PP. Diagnosis and management of piriformis syndrome: an osteopathic approach. *JAOA* 2008;108(11):657-664.

38. Di Fabio RP. Efficacy of manual therapy. *Phys Ther* 1992;72(12):853-864.

39. American Physical Therapy Association. Guide to Physical Therapist Practice 2nd ed. USA: American Physical Therapy Association; 2001.

40. Cibulka MT. The treatment of the sacroiliac joint component to low back pain: a case report. *Phys Ther* 1992;72(12):917-922.

41. Cibulka MT, Delitto A, Koldehoff RM. Changes in innominate tilt after manipulation of the sacroiliac joint in patients with low back pain. *Phys Ther* 1988;68(9):1359-1363.

42. Godges JJ, Varnum DR, Sanders KM. Impairment-based examination and disability management of an elderly woman with sacroiliac region pain. *Phys Ther* 2002;82(8):812-821.

43. Frank C, Akesow WH, Woo SL, et al. Physiology and therapeutic value of passive joint motion. *Clin Orthop* 1984;185:113-125.

44. Salter RB. The biologic concept of continuous passive motion of the synovial joints. *Clin Orthop* 1989;242:12-25.

45. Dieppe P. Osteoarthritis: are we asking the wrong question? *Br J Rheumatol* 1984;23:161-165.

46. Zusman M. Re-appraisal of a proposed neurological mechanism for the relief of joint pain with passive movements. *Physiotherapy practice* 1986; 1(2):64-70.

47. Mitchell F Jr., Moran PS, Pruzzo NA: An Evaluation of Osteopathic Muscle Energy Procedures. Pruzzo, Valley Park, 1979.

48. Lavoie BA, Devanne H, Capaday C. Differential control of reciprocal inhibition during walking versus postural and voluntary motor tasks in humans. *The Journal of Neurophysiology* 1997; 78(1): 429-438.

49. Lewit K: Manipulative Therapy in Rehabilitation of the Locomotor System, 2nd edition, London: Butterworth, 1991:pp 30-32.

50. Lewit K: Postisometric relaxation in combination with other methods of muscular facilitation and inhibition. Man Med, 1986, 2:101-104.

51. Marek T. Finding strain counterstrain. Manual Therapy Associates. http://www.collegeathletictrainer.org/symposiums/spring2005/Finding_Strain_Counterstr-Marek.pdf. Accessed March 19, 2010.

52. Sims V, Amaral M, Mesnick D. Pelvic girdle instability: identification of symptomology. http://www.sidysfunction.com/images/sisymptoms.pdf. Accessed March 19, 2010.

53. Selkow NM, Grindstaff TL, Cross KM, Pugh K, Hertel J, Saliba S. Short term effect of muscle energy technique on pain in individuals with non-specific lumbopelvic pain: a pilot study. *J Man Manip Ther* 2009; 17(1): 14-18.

54. Chaitow L. *Muscle Energy Techniques*. 3rd ed. London, England: Elsevier Limited 2006; pages 1-23.

55. Schenk R. The effects of muscle energy technique on lumbar range of motion. *J Man Manip Ther* 2009; 5: 179-183.

56. Jones LH, Kusunose RS, Goering EK. Jones Strain-Counterstrain. Carlsbad, CA: Jones Strain-Counterstrain Institute; 1995.

57. DeConinck S. Orthopaedic Medicine Cyriax: Updated Value in Daily Practice, Part II. OPTP, USA; 2003.

58. Feehan R. *The efficacy of using transverse friction massage on improving active and passive range of motion in the client with chronic knee dysfunction* [e-book]. UNION INSTITUTE; 1989. Available from: CINAHL, Ipswich, MA. Accessed March 19, 2010.

59. Fernández-de-las-Peñas C, Alonso-Blanco C, Fernández-Carnero J, Miangolarra-Page J. The immediate effect of ischemic compression technique and transverse friction massage on tenderness of active and latent myofascial trigger points: a pilot study. *Journal of*

Bodywork & Movement Therapies [serial online]. 2006;10(1):3-9. Available from: CINAHL, Ipswich, MA. Accessed March 19, 2010.

60. Lee H, Wu S, You J. Quantitative application of transverse friction massage and its neurological effects on flexor carpi radialis. *Manual Therapy* [serial online]. October 2009;14(5):501-507. Available from: CINAHL, Ipswich, MA. Accessed March 19, 2010.

61. W.I. Hammer, The use of transverse friction massage in the management of chronic bursitis of the hip or shoulder, *J Manipulative Physiol Ther* **16** (2) (1993), pp. 107–111.

62. L. Brosseau, L. Casimiro, S. Milne, V. Robinson, B. Shea and P. Tugwell *et al.*, Deep transverse friction massage for treating tendinitis, *Cochrane Database Syst Rev* **4** (2002), p. CD003528.

63. Stratford PW, Binkley JM, Riddle DL, Guyatt GH. Sensitivity to Change of the Roland-Morris Back Pain Questionnaire: Part 1. *Phys Ther* 1998; 78(11): 1186-96.

64. Williamson E. Fear avoidance beliefs questionnaire. *Aust J Physiother* 2006; 52: 149.

65. George SZ, Fritz JM, Childs JD. Investigation of elevated fear avoidance beliefs for patients with low back pain: a secondary analysis involving patients in physical therapy clinical trials. *J Orthop Sports Phys Ther.* 2008;38(2):50-58, published online 22 January 2008. doi:10.2519/jospt.2008.2647.

66. Rundle SD, Davenport TE, Wagner T. Physical therapist management of acute and chronic low back pain using the World Health Organization's international classification of functioning, disability, and health. *Phys Ther* 2009; 89(1): 82-90.

67. Byrd JWT. Evaluation of the hip: history and physical examination. *N Am J Sports Phys Ther* 2007; 2: 231-240.

68. Martin RL, Sekiya JK. The interrater reliability of 4 clinical tests used to assess individuals with musculoskeletal hip pain. *J Orthop Sports Phys Ther* 2008; 38: 71-77. http://dx.doi.org/10.2519/jospt.2008.2677

69. Broadhurst NA, Bond MJ. Pain provocation tests for the assessment of sacroiliac joint dysfunction. *J Spine* Disorders 1998; 11(4):341–345.

70. Heller M. Ilio-Sacral diagnosis and treatment, part one. *Dynamic Chiropractic*. 2003; 21(3):1-5.

71. Kalichman L, Hunter DJ. Diagnosis and conservative management of degenerative lumbar spondylolisthesis. *Eur Spine J* 2008; 17: 327-335.

72. Carrino JA, Lurie JD, Tosteson A, Tosteson T, Carragee EJ, Kaiser J. Lumbar spine: reliability of MR imaging findings. *Radioliogy* 2009; 250(1): 161-170.

73. Ranawat AS, Kelly BT. Function of the labrum and management of labral pathology. *Operative Technique in Orthopaedics* 2005; 15(3): 239-246.

74. Greaves LL, Gilbart MK, Yung AC, Kozlowski P, Wilson DR. Effect of acetabular labral tears, repair and resection on hip cartilage strain: A 7 T MR study. *J Biomech* 2010; 43(5): 858-863.

75. Grant JH. Leg length inequality in piriformis syndrome. *J Am Osteopath Assoc* 1987; 87(7): 456. PubMed PMID: 3610691.

76. Cyriax J. H. *Cyriax's Illustrated Manual of Orthopaedic Medicine*. 2nd ed. London, England: OM Publications 1996; pages 19-33.

77. Pfefer M, Cooper S, Uhl N. Chiropractic management of tendinopathy: a literature synthesis. *Journal of Manipulative & Physiological Therapeutics* [serial online]. 2009;32(1):41-52. Available from: CINAHL, Ipswich, MA. Accessed March 19, 2010.

78. Stasinopoulos D, Johnson M. It may be time to modify the Cyriax treatment of lateral epicondylitis. *Journal of Bodywork & Movement Therapies* [serial online]. 2007;11(1):64-67. Available from: CINAHL, Ipswich, MA. Accessed March 19, 2010.

79. Drechsler W, Knarr J, Snyder-Mackler L. A comparison of two treatment regimens for lateral epicondylitis: a randomized trial of clinical interventions. *Journal of Sport Rehabilitation* [serial online]. August 1997;6(3):226-234. Available from: CINAHL, Ipswich, MA. Accessed March 19, 2010.

80. Murphy BA, Dawson NJ, Slack JR. Sacroiliac joint manipulation decreases the H reflex. *Electromyogr Clin Neurophysiol* 1995; 35(2): 87-94.

81. Levangie PK. Four tests of sacroiliac joint dysfunction: the association of test results with innominate torsion among patients with and without low back pain. *Phys Ther* 1999; 79(11): 1043-1057.

TABLE 1. Examination Findings: Initial and Discharge

Examination Findings		
	Initial	**Discharge**
Pain (VAS)	6/10	2/10
ROM trunk and lower extremities	Normal	Normal
Strength of lower extremities	All 5/5 bilaterally except hip IR and ER	All 5/5 bilaterally
Strength hip rotators	Hip IR and ER 4/5 bilaterally	Hip IR and ER 5/5 bilaterally
FABER	Positive for pain and loss of motion	Negative
Sacral Distraction	Positive for pain	Negative
Sacral Compression	Positive for pain and loss of motion	Negative
Roland-Morris Questionnaire	12/24	7/24

Table 2. Sensitivity, Specificity, and Predictive Values of Special Tests for Sacroiliac Pain

Author	Test	Sensitivity	Specificity	(-) Predictive Value	(+) Predictive Value
Dreyfuss, 1996	Sacral sulcus tenderness	95%	9%	NA	NA
Broadhurst, 1998	FABER	77%	100%	NA	NA
Laslett, 2005	Distraction	60%	81%	60%	81%
Laslett, 2005	2 or more positive tests *	93%	66%	96%	58%
Laslett, 2005	3 or more positive tests *	94%	78%	96%	68%
Laslett, 2005	4 or more positive tests *	60%	81%	81%	60%
Laslett, 2005	5 or more positive tests *	27%	88%	72%	50%

***Tests performed: right and left Gaenslen sign, sacral distraction, thigh thrust, sacral compression, and sacral thrust**

Table 3. Treatment Progression

Intervention	Session											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Muscle energy technique for left anterior innominate	X								X			
Hip Exercises with yellow theraband								X	X	X	X	X
a) Hip extension								X	X	X	X	X
b) Hip abduction								X	X	X	X	X
c) Hip adduction												
Review of home exercise program	X											
Seated on physioball		X	X	X	X	X	X	X	X	X	X	X
a) Alternating Long arc quad 1 set of 15 reps		X	X	X	X	X	X	X	X	X	X	X
b) Sit back (3" hold) 1 set of 15 reps		X	X	X	X	X	X	X	X	X	X	X
c) Alternating Hip flexion 1 set of 15 reps												
Quadriped Transverse Abdominus bracing			X	X	X	X	X	X	X	X	X	X
Straight leg raise with Transverse Abdominus bracing			X	X	X	X	X	X	X	X	X	X
Seated on physioball: lifting 1# overhead with Transverse Abdominus bracing			X	X	X	X	X	X	X	X	X	X
Standing hip flexion with yellow theraband				X	X	X	X	X	X	X	X	X
Grade 3 sustain posterior to anterior sacral mobilization at the left lateral inferior angle				X	X					X	X	X
Single lower extremity bridging with ipsilateral straight leg raise and external rotation					X	X	X	X	X	X	X	X
Seated right hip internal rotation					X	X	X	X	X	X	X	X
Seated left hip external rotation						X	X	X	X	X	X	X
Wall squats with 45cm ball						X	X	X	X	X	X	X
Strain counterstrain left latissimus dorsi							X					
Strain counterstrain right piriformis		X									X	
Transverse Friction Massage right sacrotuberous ligament			X									
Muscle energy technique and manual stretch left quadratus lumborum								X				
An X denotes that exercise was performed in that session. **All exercises performed for 2 sets of 15 reps unless otherwise noted.**												