Registered Massage Therapists' Association of British Columbia

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Plantar fasciitis: a case report on the effects of massage therapy and homecare intervention

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ABSTRACT

Background: Plantar fasciitis (PF) is a common condition effecting the plantar fascia, causing heel pain, and affects approximately 10% of the North American population (Covey & Mulder, 2013). Although previously described as a biomechanical overuse condition resulting in inflammation of the plantar fascia (Rattray & Ludwig, 2000), more recent research has shown, it is more degenerative. The following case study was conducted to further explore the effectiveness of massage therapy modalities as the primary treatment of chronic PF, without any conjunction of other interventions. Chronic PF can be treated and maintained with massage therapy and appropriate homecare intervention.

Methods: The treatment plan consisted of 8 bi-weekly treatments administered over 6 weeks, with a 1 month follow-up assessment. Session times were between 90 to 120 minutes, treatments being between 30 and 100 minutes, hands-on. Treatment and assessment areas included low back, gluteal region, anterior and posterior thigh, anterior and posterior leg and feet, bilaterally. Techniques used included fascial, passive and active stretching, hydrotherapy, resisted range of motion, joint mobilizations, massage and a detailed homecare routine including walking, stretching, strengthening, and hydrotherapy.

Results: Though at the end of the study period, 6 weeks of treatment and 10 weeks in total, the patient still experienced some foot pain, the majority of the signs and symptoms presented in the initial assessment had dissipated completely. The patient's ability of physical activities had increased, and the onset of pain was later in the exercises, as shown on the homecare journals. Great strides in overall flexibility and strength were noted, and moderate ankle swelling reduced to mild or nonexistent. Weight distribution and joint stability improved at the ankle. Many positive changes occurred from the treatments.

Conclusion: Plantar fasciitis is a common condition that can be effectively treated with massage therapy and appropriate homecare intervention, as a primary form of treatment. Overall the treatments were effective for PF, as well as other musculoskeletal abnormalities presented by the patient at the start of the study. The primary goals of treatment to decrease pain and increase the patient's ability to perform physical activity were met by the end of the study period. Results of the examinations demonstrated many improvements to special tests, decreased palpable pain, swelling, and mobility. More research is needed on specific interventions without integration of other modalities, to argue the effectiveness of manual therapy as treatment for PF.

Key Words: Plantar Fasciitis, Plantar Fascia, Massage Therapy, Physical Therapy, Homecare

INTRODUCTION

Epidemiology

Plantar fasciitis (PF) is a common condition effecting the plantar fascia, causing heel pain, and affects approximately 10% of the North American population (Covey & Mulder, 2013). Plantar Fasciitis affects 2 million people per year, half of which will seek medical care from their physicians (Young, 2012). PF typically occurs in women twice as often as men and commonly effects adults over the age of 40 years old but may also be present in athletic populations at as early as 20 years of age (Rattray & Ludwig, 2000).

Definition

PF was thought to be an inflammatory condition; however newer research has shown that PF is more similar to a tendinopathy involving "collagen degeneration, fiber disorientation, increased ground substance, and an absence of inflammatory cells" (Young, 2012, p.ITC1-2), of the plantar fascia. Although previously described as a biomechanical overuse condition resulting in inflammation of the plantar fascia (Rattray & Ludwig, 2000), more recent research has shown, it is more degenerative. The name that researchers are advocating for PF is Plantar Fasciosis to imply the more degenerative nature of the condition (Covey & Mulder, 2013).

Structures

Plantar fascia is an aponeurosis with a large central portion with smaller slips on the medial and lateral sides that originates from the calcaneal tuberosity, inserts into the metatarsal heads, then further blends in with the fibrous flexor sheaths on the plantar aspect of the phalanges. Functionally, the plantar fascia serves as a "passive bowstring during the midstance

phase of the gait cycle, approximating the calcaneus and the metatarsals" (Rattray & Ludwig, 2000, p. 417) raising the medial longitudinal arch.

Pathophysiology

Plantar fascia and the Achilles tendon are fascially connected and absorb greater than normal compressive forces in situations of excessive supination or pronation that commonly occurs with pes cavus or pes planus and increased body weight. After an initial period of acute inflammation, the healing process sets in and causes adhesions and fibrosis, thickening the fascia. Microtearing occurs at the calcaneal enthesis by stretching of the plantar fascia, intrinsic foot muscles and supporting ligaments. In more extreme chronic cases, recalcitrant plantar fascia is unable to repair itself, as it is poorly vascularized, and slowly starts to detach off of the calcaneal attachment.

Theories state that repeated microtearing and continual stress on the calcaneal attachment causing reinforcement of connective tissue deposits, which over time converts to fibrocartilage, and furthermore into bone, create bone spurs at the calcaneus (Rattray & Ludwig, 2000). The relation between PF and bone spurs is inconclusive but studies have shown that heel spurs occur in 15% to 25% of the general population and are often absent in PF patients, though the presence of heel spurs will increase the risk of PF by 77% to 85% (Young, 2012).

Etiology

Direct causes of PF are indistinct and often multi-factorial, intrinsically and extrinsically. Known risk factors include anatomical variations such as foot pronation, pes planus, pes cavus, leg length discrepancy, excessive tibial external rotation, excessive femoral anteversion and the normal aging process of degeneration. Functional risks consist of tight or weak gastrocnemius,

soleus, and intrinsic foot musculature, and therefore the Achilles tendon, and increased weight. Prolonged standing or walking, sedentary lifestyle, overuse, training errors, and improper footwear can also play a role in the cause of PF (Young, 2012). Examples of predisposing factors would be poor biomechanics as with excessive pronation and supination of the subtalar joint or excessive external rotation of the hip during gait, and when ankle plantarflexion and metatarsophalangeal (MTP) joint extension occur at the same time, as happens in activities such as dancing and running (Rattray & Ludwig, 2000).

Signs & Symptoms

PF can be unilateral or bilateral, range from mild to severe, edema may be present and typically symptoms have a slow onset without history of injury or trauma. Common symptoms include pain with first few steps after a period of prolonged non-weight bearing activity, such as sleeping or sitting, and dissipates after about 30 minutes of mobility. Symptoms will often increase after a few hours of weight bearing activity and may be relieved by rest. Pain is usually concentrated at the calcaneal attachment of the plantar fascia or along the medial border of the mid-foot (Rattray & Ludwig, 2000). As Rattray & Ludwig stated, active and passive extension of the MTP joint causes pain, due to the stretch of the plantar fascia and intrinsic foot muscles. No neurologic symptoms are usually present and in most cases, symptoms usually resolve completely within 2 years of onset.

Differential Diagnosis

Other conditions that mimic the signs and symptoms of PF would comprise of weight gain, improper footwear, longitudinal arch strains, stress fractures of the calcaneus, contusion of the fat pad of the heel from overuse and tarsal tunnel syndrome; these may be caused by similar

risk factors as PF (Young, 2012). Ultrasonography is an comparably inexpensive procedure that can confirm PF from other pathologies with diagnostic findings of plantar fascia thickening, near the origin, that is greater than 4 mm and areas of hypoechogenicity, or a low sound wave return, indicating a denseness of the tissue (Goff & Crawford, 2011).

Massage Therapy Research

Specific massage therapy techniques or modalities for the treatment of PF have yet to be thoroughly researched and published; however some physical therapy has been explored. Patients are typically referred to a physical therapist for customization of a stretching, strengthening, and a taping routine, when medications have no positive effects (Young, 2012). Most evidence of deep myofascial massage shows improvement in the healing process by increasing blood circulation to the treatment area; however the research for deep myofascial massage is anecdotal (Goff & Crawford, 2011). Intrinsic foot muscles and plantar fascia stretching techniques have shown to reduce patient's discomfort (Goff & Crawford, 2011). Stretching techniques, orthotics, and night splints are all supported by firm clinical evidence of benefit (Covey & Mulder, 2013).

Trigger-Point therapy, when combined with plantar fascia-specific stretching, has improved self-reported physical function, more than just stretching alone (Covey & Mulder, 2013). As stated by Costa & Dyson (2007), "Stuber concluded that the use of joint mobilizations and manipulation, stretching of the plantar fascia and Achilles tendon, orthotics and night splints were recommended over other forms of conservative treatment" (p. 167). There is supportive evidence that eccentric stretches improve many types of tendinopathies, but not enough PF

specific research has been completed (Goff & Crawford, 2011). More research is necessary to conclude the effectiveness of manual therapy for the treatment of PF.

Available Treatments & Research

A variety of treatment options, other than physical therapy, are available and range from non-invasive to surgical interventions; however studies done have shown the effective results to be conflicting (Covey & Mulder, 2013). Innovative treatment interventions are currently being tested based on this degenerative pathology and commonly include local corticosteroid injections (CSI), ultrasonography, extracorporeal shockwave (ECSW) therapy, plantar fasciotomy (Goff & Crawford, 2011) and more recently, platelet-rich plasma (PRP) injections (Akşahin et al., 2012), and iontophoresis (Covey & Mulder, 2013), among others. Although these more modern interventions have been increasingly used in the medical field, the positive effects and possible negative effects have not been clearly established through research. Conversely, research has shown, 90% of patient's signs and symptoms improve with conservative treatments such as rest, activity modifications, and physical therapy such as stretching and strengthening exercises (Goff & Crawford, 2011).

Analgesic Medication

Originally, Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) were believed to help reduce the inflammation of the condition, however since the discovery of the degenerative nature, NSAIDs are primarily used to manage the associated pain (Young, 2012). Physician's first line of defence with PF typically includes NSAIDs and rest (Young, 2012). Although results show short term improvement in pain relief and disability, there are few studies that show the effects of the rest and analgesic method without the presence of another intervention. Poor

evidence on the best modality or the effects of one modality exist due to many therapies being used in combination (Goff & Crawford, 2011).

Foot Supports

Supporting the arch of the foot with heel cups, orthotics, and night splints reduces foot pronation and stress on the plantar fascia, and therefore reduces the pain (Young, 2012). Night or tension splints serve for a moderate amount of stretching of the calf and plantar fascia over night, to reduce the pain (Young, 2012). Although effective when used, patient discomfort has been shown to decrease patient compliance to using the night splints (Covey & Mulder, 2013). A Cochrane review showed little evidence which suggested that custom orthotics have better results than the prefabricated orthotics (Goff & Crawford, 2011). Arch taping is usually used in conjunction with physical therapy but the pain relief, most substantially with the first steps of weight bearing, is short term (Goff & Crawford, 2011). Covey & Mulder (2013) stated that a "recent study demonstrated that rocker sole shoes - a type of therapeutic footwear with a more rounded outsole contour - combined with custom orthotics significantly reduced pain during walking" (p.469); however the effects of the rocker sole shoes needs further research.

Corticosteroid Injections

Corticosteroid injections are typically used when patients do not respond to "first-line" treatments; however because of the degenerative nature, the injections only seem to have limited short term effectiveness and many potential side effects (Young, 2012). Corticosteroid injection use for acute and chronic PF have proven to be effective but have possible risks of fat pad atrophy, skin atrophy, infection, tendon rupture and plantar fascia rupture (Goff & Crawford, 2011).

Platelet-Rich Plasma Injections

Autologous blood, or PRP injections, is a more recent intervention based on the theory that the substances would initiate an acute inflammatory response assisting the healing process; evidence of the effectiveness is limited (Young, 2012).

Covey & Mulder (2013) found the following:

> "PRP is a component of whole body blood that is centrifuged to a concentrated state, treated with an activating agent, and injected into the affected area. Theoretically, injecting PRP increases the release of reparative growth factors, enhancing the healing process" (p. 470).

A decrease in plantar fascia thickness and pain, and an increase in functional ability have been results of PRP injections and the most common risk is post-procedural pain. More evidence is needed to support these findings (Covey & Mulder, 2013).

Extracorporeal Shock Wave Therapy

ECSW helps the healing process of degenerative tissue by promoting neovascularization, but have side effects that may include pain during or after the procedure, local swelling or ecchymosis, and numbness with dysesthesia. Although most research confirms that ECSW therapy improved function and decreases pain by 34% to 88% in cases with PF (Covey & Mulder, 2013), the effectiveness of this modality has had conflicting results (Goff & Crawford, 2011).

Iontophoresis

"Iontophoresis is a non-invasive drug delivery system that uses a low electrical current to deliver aqueous ionic solutions transdermally to superficial areas" (Costa & Dyson, 2007 p. 167). Physiological responses to chronically inflamed tissue results in higher concentrations of calcium carbonate which contributes to the pain cycle. The ionic solution combines with the calcium carbonate to form calcium acetate and then can be removed within local blood circulation from the site of injury (Costa & Dyson, 2007), thus reducing pain.

Plantar Fasciotomy

The most invasive intervention, plantar fascia release or fasciotomy, is for patients who show no response to other interventions and either has passed the 2 year spontaneous resolution time frame or are unable to wait due to pain and inability to continue activities of daily living. This modality includes many risks such as loss of arch, scarring, infection, nerve damage, calcaneal fracture and chronic pain (Young, 2012). Studies have shown that about 80% of patients who receive a plantar fasciotomy are satisfied with the results; however the disadvantages include incision care, immobilization, potential complications and a long recovery time (Goff & Crawford, 2011). After surgical intervention about 35% of patients will have recurring symptoms (Covey & Mulder, 2013).

Other

Most recently, the injection of the botulinum toxin has been used, but still is an experimental procedure (Young, 2012). Percutaneous fenestration, or dry needling, has also shown results in pain relief in about 4 weeks (Goff & Crawford, 2011). Both modalities need more supportive research.

Objective & Hypothesis

The following case study was conducted to further explore the effectiveness of massage therapy modalities as the primary treatment of chronic PF, without any conjunction of other interventions. Chronic PF can be treated and maintained with massage therapy and appropriate homecare intervention. Whereas an argument may be that manual therapy and appropriate homecare is only a temporary solution for Chronic PF.

METHODS

Assessment Plan

There were assessments done every treatment, as well as four major assessments using an array of techniques and data collection tools. Full assessments were done from low back to ankle due to patient history and presentation, and also to determine if any other contributing factors were effecting the condition. These assessments were performed, and data obtained, prior to initial treatment, prior to the midpoint treatment, after the last treatment and at 1 month after the last treatment.

Observation

During postural assessment, excessive pronation and signs of swelling in the longitudinal arch were expected. Gait analysis usually present with excessive external rotation of the hip, or abducted gait, and pain would be reported during the pre-swing, or toe-off, stage. Adhesions may be palpable near the calcaneal attachment and midfoot. Pain would be elicited with pressure to the anteromedial aspect of the calcaneal attachment (Rattray & Ludwig, 2000).

At the beginning of each session, a postural exam was performed to gain information of any initial or changing visual deformities, abnormalities in alignment and asymmetries that may be present. Pictures of the ankles during weight bearing posture and gait videos were obtained during the four main assessments.

Examination

Length tests for gastrocnemius and soleus musculature would show shortness. Resisted testing such as unilateral foot hopping would elicit pain and reveal weak intrinsic foot muscles (Rattray & Ludwig, 2000).

For each session, physical examinations were conducted on the treatment table during treatment and any abnormal or new findings were recorded. To determine detailed changes, full examinations were conducted four times during the study period.

Special Tests

Many special tests were conducted for the thoroughness of this study and to help recognize any contributing factors to the patient's PF. Special tests were performed as dictated in Magee (2008). All special tests, regardless of the testing results, were performed four times during the major assessments of the study period. See Table 1 for special tests used.

Table 1 - Special Tests Used

Low Back	Pelvis	Hip	Knee	Ankle
Babinski's	Approximation (Transverse Posterior Stress)	Craig's	Anterior Drawer	Achilles Reflex (S1/S2)
Beevor's	Femoral Shear	Faber (Patrick's)	Apley's	Anterior Drawer of the Ankle
Dural Slump	Functional Hamstring Length	Leg Length Discrepancy	Clarke's (Patellar Grind)	External Rotation Stress
Femoral Nerve Tracking	Gapping (Transverse Anterior Stress)	Noble Compression	McMurray's	Feiss Line
Gluteal Skyline	Gillet's Sacral Fixation (Ipsilateral Posterior Rotation)	Ober's	Mediopatellar Plica	Figure 8 Measurement
Hoover's	Piedallu's (Seated Flexion)	Piriformis Stress	Patellar Reflex (L3/L4)	Forefoot-Heel Align
Lateral Lumbar Spine Stability	Prone Gapping (Hibb's)	Rectus Femoris Contracture	Posterior Drawer	Gastrocnemius/ Soleus Girth
Prone Knee Bend (Nachlas)	Sacral Apex Pressure (Prone Springing)	Scouring (Quadrant)	Q Angle	Leg-Heel Align
Quadrant	Sacroiliac (SI) Rocking (Sacrotuberous Ligament Stress)	Supine-to-Sit (Long Sitting)	Valgus Stress (Abduction)	Morton's
Schober's	Squish	Thomas	Varus Stress (Adduction)	Posterior Tibial Reflex (L4/L5)
Segmental Instability Test	Thoracolumbar Fascia Length	Weber-Barstow		Tinel's
Sign of the Buttock	Torsion Stress			Dermatomes: L1-S2
Standing Stork	Trendelenburg's			Myotomes: L1-S2
Straight Leg Raises (SLR)	Yeoman's			
Valsalva				

Special tests from low back to ankle throughout study

Outcome Measure Tools

Many outcome measure tools were used to collect data in a variety of ways to help the validity of the data. All tools were used during the four main assessments during the study period, except for the homecare journal that was used by the patient daily. All data collected was not analysed during the study period to maintain the regularity of treatment and procedures.

A questionnaire was created based on a Oswestry Questionnaire, with minor details changed to become more suitable for PF. This method would produce some qualitative and quantitative data regarding pain with sitting, standing, walking, sleeping habits, pain intensity, social life, and changing degrees of pain. A visual analog pain scale (VAS) was also included on this form. Refer to Appendix A.

An iPhone application, iGonio developed by Z & Z, was used to measure angles from photographs taken of the patient. This application was used to measure the Q Angle and Feiss Line degree fluctuation. This produced a source of comparable quantitative data. The camera of an iPad was used to take all pictures and videos of gait.

A weekly homecare journal was created for the patient to fill out on a daily basis to record what homecare was done and at what duration, intensity, and onset of pain, if any. The patient was instructed to maintain a treadmill routine as part of homecare to monitor any changes in pain patterns during walking. There was also a section for notes that the patient would fill in with any additional information about experiences or life events. Refer to Appendix A.

PATIENT PROFILE

The case study is a 48 year old female accountant. She is 5 foot 5 inches tall; an endomorph body build and leads a sedentary lifestyle. She had complaints of moderate heel pain bilaterally, more on the left side than the right, that started 2 years ago. Symptoms included pain with first few steps in the morning and after a period of prolonged sitting. Pain was aggravated with standing and walking and relieved by sitting and use of medications. Mechanism of injury was unknown but was likely to be precipitated by her sedentary lifestyle, increased weight, flat feet or fallen arches, and chronic low back and knee pain. Plantar fasciitis was diagnosed by her Physician and Chiropractor 2 years prior to the study period.

Until February 2014, the patient was on disability leave for 3 years time due to severe depression and migraines. In this time she had seen a Massage Therapist, a Chiropractor, a Naturopath, and an Acupuncturist for treatment of depression, migraines, back pain, and foot pain. The patient had not seen any healthcare professionals 5 months prior to the start of this case report. Other diagnosed conditions include high blood pressure, high cholesterol, anxiety, loss of sleep, neck pain, tinnitus, vision difficulties, asthma, and ankle edema. The patient's prescribed medications included Nadodol, Clomipramine, Trazodone, Crestor, Meloxicam and Cyclobenzaprine; see Table 2 for prescribed use and doses. The patient's non-prescribed supplements included a Multivitamin, Omega-3, Vitamin D, Probiotics, CoQ10, Calcium, CLA, Green tea and Magnesium. The patient is a non-smoker and an occasional alcohol consumer.

Table 2 - Patient's Prescription Medication

Medications	Dose	Indicated Use
Nadadol	80 mg 1x/day	Migraines
Crestor	20 mg 1x/day	High Cholesterol
Trazodone	50 mg 1x/day	Depression and Sleep Disturbances
Clomipramine	75 mg 1x/day	Depression
Meloxicam	15 mg 1x/day as needed	Neck, Back and Feet Pain
Cyclobenzaprine	10 mg 3x/ day as needed	Neck, Back and Feet Pain

The patient had her tonsils removed at age 6 and appendix removed at age 47. No previous injuries have been noted other than a motor vehicle accident at age 25 that resulted in a moderate head injury, chronic upper back and neck pain. Patient had birthed 2 healthy children, whom are now in adulthood. Family history of the patient included heart disease, diabetes, COPD, asthma, emphysema and osteoarthritis.

Patient Desired Outcome

The patient's overall goals for the case study were to reduce the foot pain she experienced and increase the amount of exercise she was able to do without pain. She hoped to address other heath issues, not related to the study, with the ability to do more physical activity. Refer to Appendix B.

Contraindications

Treatment should be altered if acute inflammation is present, the subject has recently taken anti-inflammatory medications, or has history of corticosteroid injections to the plantar fascia. Contraindications directly pertaining to the patient included deep vigorous work, heat on upper back, neck, or extremity during any headache or migraine symptoms. Maintaining a fragrance free environment as this may trigger symptoms, and awareness of lighting and music

during treatment. Treatments were not contraindicated during a migraine if the patient was able to tolerate the treatment. Heat on abdomen is contraindication for high blood pressure. Treatments were conducted in progressive phases to not over tax the patient physically; migraines were commonly caused by vigorous activity.

TREATMENT PLAN

The treatment plan consisted of 8 bi-weekly treatments administered over 6 weeks, with a 1 month follow-up assessment. Session times were between 90 to 120 minutes, treatments being between 30 and 100 minutes, hands-on, depending on the treatment and assessment time needed. Treatment and assessment areas included low back, gluteal region, anterior and posterior thigh, anterior and posterior leg and feet, bilaterally. Prior to each treatment a follow-up of any changes or results from the previous treatment and homecare were discussed and the patient was asked to demonstrate what they did for homecare to confirm correct form and compliance.

Treatment techniques progressed in phases throughout the study as the patient had lead a sedentary lifestyle for over 3 years and received no previous treatment in the 5 months prior to the study period; it was a precaution not to overexert the patient physically.

Phase 1: Treatments 1 - 2

An introduction of fascial techniques, passive stretching, hydrotherapy and joint mobilizations to treatment. Introduction to treadmill exercises, hydrotherapy, and stretching as homecare.

Fascial techniques used included crossed hand shearing, 3 dimensional torsion, pin and stretch, picking up, muscle peeling and bowing, and were applied to the quadriceps, hamstring,

gastrocnemius, soleus, tibialis anterior musculature and plantar fascia, bilaterally. Passive stretching was used for the quadriceps, hamstring, gastrocnemius, and soleus musculature, achilles tendon and plantar fascia. The hydrotherapy applied included deep moist heat (DMH) to the quadriceps, hamstring, gastrocnemius, soleus musculature and plantar fascia prior to stretching and ice was applied to the plantar fascia post treatment to help reset the fascial stretching. Joint mobilizations were applied to the hip, or acetabulofemoral (AF) joint, femorotibial (FT) joint, proximal tibiofibular (TF) joint, patella, mortise, or talocrural joint, calcaneus, cuboid, navicular, all cuneiforms, metatarsals (MT), and MTP joint, bilaterally.

Homecare included treadmill walking, with running shoes, at a 2.1 kph speed, to pain tolerance, 3 to 4 times per week and record the length of total time, time at onset of pain, and reason for stopping the treadmill exercise. Many forms of hydrotherapy were given as homecare, the first being up to or equal to 20 minutes of DMH prior to stretches given. Secondly, a contrast foot bath (CFB) was given to complete after a treadmill session, and was structured as a set including 3 minutes of hot or warm water submission to patient tolerance followed by 1 minute of cool or cold application, to patients tolerance. The patient was instructed to complete 3 sets of the CFB cycle, always ending with cold. Lastly, the patient was instructed to fill a 591 ml water bottle and let it freeze into an ice form. The frozen water bottle was used by rolling the plantar surface of the foot on the bottle, after stretching of the plantar fascia, using the method of C-BAN, or cold to burning to aching to numb. At the numb stage of the cycle the patient was advised to remove the ice bottle. Finally stretching exercises were given for the quadriceps, hamstrings, gastrocnemius, and soleus musculature and plantar fascia. All stretches were instructed to be done to the point of a pain free 'stretch' feeling, held for 30 to 60 seconds each, 3 to 5 times a day, every day during the study period.

Phase 2: Treatments 3 - 5

Treatments continued and progressed to include resisted range of motion (RROM) and proprioceptive neuromuscular facilitative (PNF) stretching. Addition of strengthening exercises were applied to homecare.

An introduction to PNF stretching was administered with an eccentric and concentric directional force to the quadriceps, hamstrings, and gastrocnemius musculature. Gluteal knuckle kneading was performed bilaterally to gluteus maximus, gluteus medius and gluteus minimus. RROM was applied in a concentric and eccentric directional force to the gluteal group, vastus medialis, tibialis anterior, gastrocnemius, soleus, and intrinsic foot musculature at 10 repetitions each, bilaterally.

Phase 3: Treatment 6 - 8

Previously described treatment was continued with the addition of manual massage and advanced fascial techniques. No further changes were made to the previous homecare interventions given.

Swedish techniques included picking up, wringing, kneading, and c-scooping to the gluteal group, anterior thigh and leg, posterior thigh and leg, and feet, bilaterally. Deep point pressure was applied between the proximal and posterior Tibia and Fibula with the intention to release the interosseus membrane fascia, a new technique used by osteopaths, within the scope of an registered massage therapist (RMT).

Treatment Rationale

Treatment should include deep moist heat application prior to stretching of the gastrocnemius and soleus fascia, contrast application can be used at the end of the treatment to increase circulation (Rattray & Ludwig, 2000). According to Rattray & Ludwig, compensatory structures such as low back, gluteals, and thighs should be included with treatment to affected areas along with fascial techniques, longitudinal stroking, kneading, passive and active stretching, joint play, and cross-fibre frictions (2000). Homecare should include rest from aggravating activities, ice application to plantar surface after painful activities, heat application prior to activity and stretching, stretch and strengthening exercises to intrinsic foot muscles, gastrocnemius, soleus and intrinsic foot musculature (Rattray & Ludwig, 2000). "Stretches targeted at the plantar fascia are particularly important. Stretching with the ankle and metatarsal-phalangeal joint in maximal dorsiflexion results in the most stress in the plantar fascia" (Young, 2012, p.ICT1-10). Stretching in the morning before the first steps and throughout the day after weight-bearing activity can help reduce the pain. Stretching the healing tissues, dynamically, after homecare helps to reset the plantar fascia (Young, 2012).

Treatment Goals

Treatment should be geared towards the common goals of alleviating pain and increasing tolerance for activity. Education should be an integral part of treatment as patients are more likely to comply with their treatments if they understand the cause of their pain and the reasons for the specific techniques and modalities (Young, 2012).

RESULTS

Though at the end of the study period, 6 weeks of treatment and 10 weeks in total, the patient still experienced some foot pain, however the majority of the signs and symptoms presented in the initial assessment had dissipated completely. The patient's ability of physical activities had increased, and the onset of pain was later in the exercises, as shown on the homecare journals. The patient's body weight had decreased by 3 lbs between March 28 and June 6 2014. Great strides in overall flexibility and strength were noted, and moderate ankle swelling reduced to mild or nonexistent. Weight distribution and joint stability improved at the ankle. Overall, many positive changes occurred from the treatments. Refer to Tables 3 to 7 for data findings from examinations.

Observational Baseline Presentation

The patient presented with moderate head forward posture (HFP), and slight torticollis on the right side causing the head and neck to tilt to the right and slightly rotate to the left. The left shoulder girdle was slightly elevated higher than the right in the anterior view. The inferior angle of the right scapula was slightly elevated more than the left in the posterior view. The left leg, including the knee, were turned out slightly into external rotation in the anterior view; the left foot pointed about 40° towards the left. The left ankle presented with more swelling than the right. The right foot appeared to be slightly supinated at the subtalar joint . The patient had flat feet, or pes planus, slightly more on the left side.

Mid-Point Observational Presentation on April 11 2014

The patient presented with moderate HFP and the torticollis on the right side was no longer present. The shoulder girdles seemed to be more equal anteriorly and posteriorly. The left

leg, including the knee, was still turned out slightly into external rotation in the anterior view; The left foot pointed about 30° towards the left, less than initial assessment. The left ankle presented with more swelling than the right. The right foot appeared to be slightly supinated at the subtalar joint. The patient had flat feet, or pes planus, slightly more on the left side.

Post-Treatment Observational Presentation on May 8 2014

The patient presented with slight to moderate HFP and the left leg, including the knee, was still turned out slightly into external rotation in the anterior view; the left foot pointed about 20° towards the left, less than initial and mid-point assessments. The left ankle presented with moderately more swelling than the right. The right foot appeared to be less supinated at the subtalar joint. The patient had flat feet, or pes planus, slightly more on the left side.

1 Month Follow up Observational Conclusion on June 6 2014

The patient presented with moderate HFP and the left foot pointed still about 20° towards the left, the same as the last assessment. Swelling was quite mild and fairly even bilaterally. The right foot appeared to be slightly supinated at the subtalar joint. The right subtalar joint appeared to be distributing weight more evenly, similar to the left foot. The patient had flat feet, or pes planus, slightly more on the left side.

Table 3 - Low Back Examinations

MARKER	MARCH 28	APRIL 11	MAY 8	JUNE 6
Low Back Pain	PSIS 'Lock'			
Night Pain Relieved by Position Change	Only temporary			
Night Pain – No Relief w/ Movement	Constant movement to stay comfortable			
Bladder Incontinence	Functional/Stress **<5** min hold ability	Functional/ Stress **<10** min hold ability	Functional/ Stress **<10** min hold ability	Functional/ Stress **<15** min hold ability
Leg Pain w/ Walking	Fast pace 15 min > Casual pace 1 hr	Fatigue (no pain), 15 – 60 min variable pace		
Pain w/ Palpation	PSIS R=L			
Straight Leg Raise (SLR)	+ Bilat (Hip pain R>L)			

Chart showing clinically significant observational and examination data collected for the low back

Table 4 - Pelvis Examinations

MARKER	MARCH 28	APRIL 11	MAY 8	JUNE 6
Local Pain	Posterior R>L			
Functional Hamstring Length		+ R only		
Prone Gapping	R pain w/ bilateral test			
Sacral Apex Pressure	R pain			
SI Rocking	R pain ipsilateral test			
Torsion Stress	Contralateral pain, bilateral			
Yeoman's	L side only			

Chart showing clinically significant observational and examination data collected for the pelvis

Table 5 - Hip Examinations

MARKER	MARCH 28	APRIL 11	MAY 8	JUNE 6
Lateral Hip Pain	Disturbs sleep in side lying			
Hip Pain w/ Walking	Fast pace 15 min > Casual pace 1 hr			
Leg/Thigh Pain w/ Walking	Fast pace 15 min > Casual pace 1 hr			
Night Pain – Relieved by shifting	Constant shifting			
Palp. Pain – Greater Trochanter	R>L	R=L		
Palp. Pain – Piriformis	R>L	R=L		
Squatting		R Crepitus	Same	Less
Faber's	+ Bilaterally			
Leg Length Discrepancy	R= 87 cm & L= 88.5 cm			
Noble Compression	Bilateral pain	Same		
Ober's	+ Bilaterally	Same	+ L	+ L
Rectus Femoris Contracture	+ Bilaterally			
Supine-to-Sit	R=L to L>R (Move)			
Thomas	+ Bilaterally			
Weber-Barstow	R Tib= Inf & R Femur=Sup	Same	Same	L Sup

Chart showing clinically significant observational and examination data collected for the hip

Table 6 - Knee Examinations

MARKER	MARCH 28	APRIL 11	MAY 8	JUNE 6
Local Pain	R>L	R>L	When provoked	Rare
Pain w/ Activity	Y			
Swelling	W/ Pain			
Crepitus		R	R	Rare
Leg Pain	5/10, achy	0/10, tight		
Palp. Pain – Knee	R>L	R>L		
Plical Pain	R>L	R>L		
Clarke's	+ R	+ R	+ R	+ R 'shooting'
Mediopatellar Plica	+ R w/ crepitus	+ R w/ crepitus		
Q-Angle	R=7° & L=10°	R=8° & L=9°	R=9° & L=7°	R=7° & L=10°

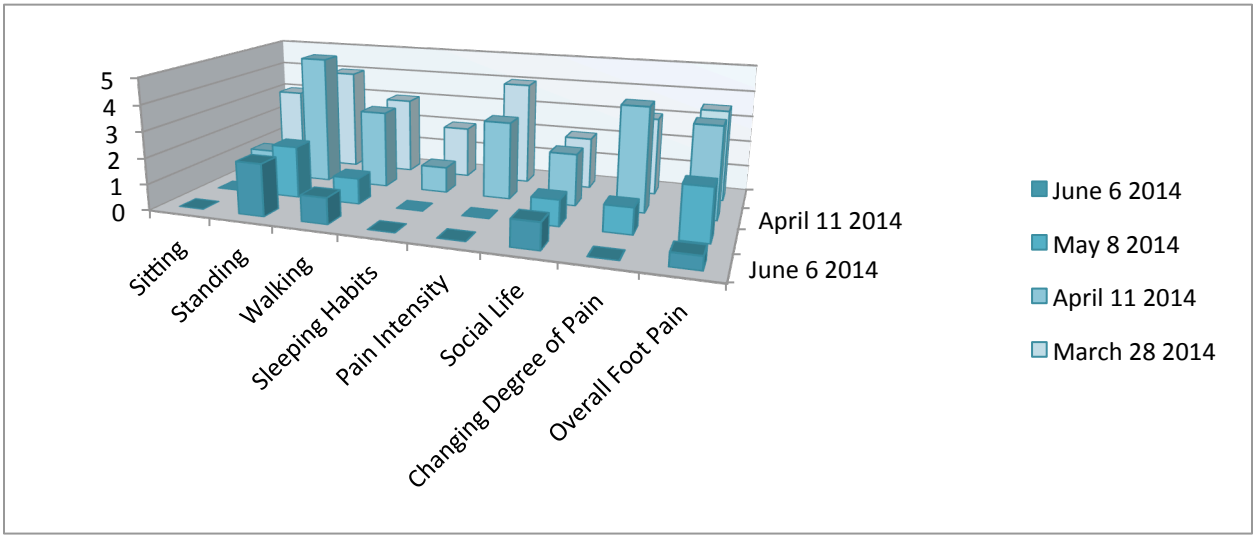
Chart showing clinically significant observational and examination data collected for the knee

Table 7 - Ankle Examinations

MARKER	MARCH 28	APRIL 11	MAY 8	JUNE 6
Local Pain	R=L	R=L	Less	
Swelling	L>R Lat. Malleoli	Less	R=L	Slight L
Foot Pain	Y – Sharp	Y – Sharp		
Radiation to Leg	Y	Y		
Foot Type	Pes Planus	Same	Same	Same
Feiss Line	R=L @ 19°	R=10° & L=19°	R=18° & L=23°	R=3° & L=20°
Sural Girth		Inf: 1 cm		
Leg-Heel Alignment	R=L Lateral Bowing of Achilles Tendon	Same	Same	L>R

Chart showing clinically significant observational and examination data collected for the ankle

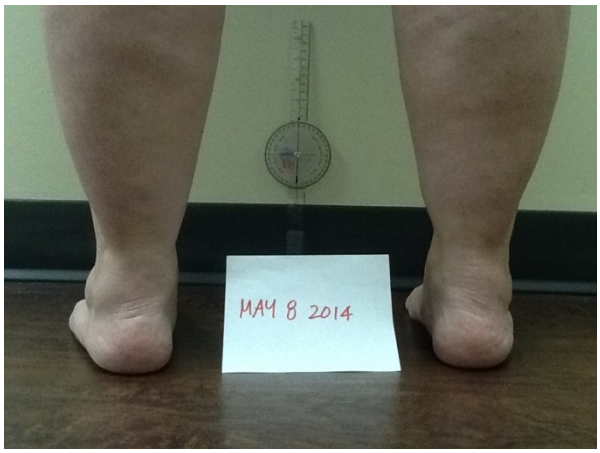
Table 8 - Questionnaire Results - *Overall decrease over the study period.*



Pictures - Posterior View of Ankle

March 28 2014 - Posterior View

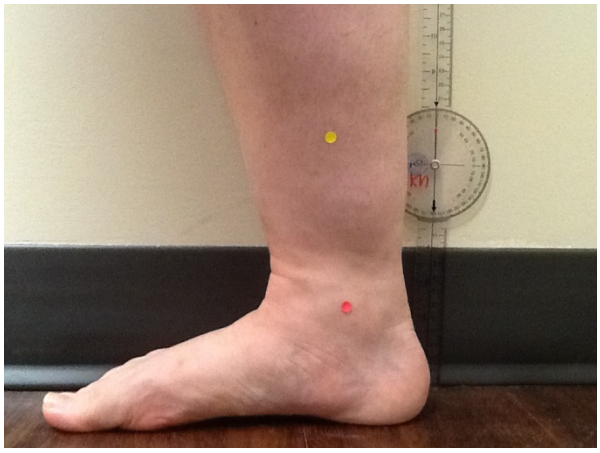
April 11 2014 - Posterior View



May 8 2014 - Posterior View

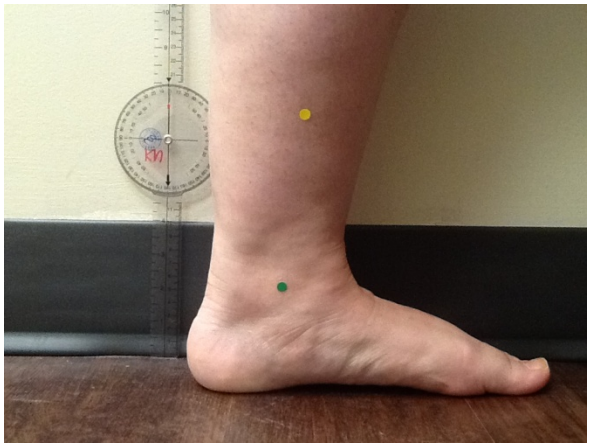
June 6 2014 - Posterior View

Pictures - Medial View of Ankle

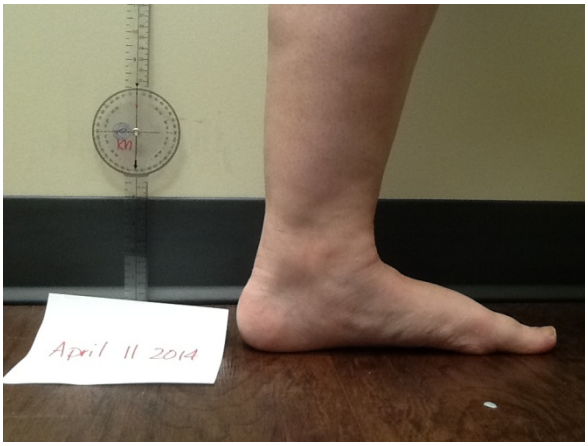


March 28 2014 - Medial View - Right

April 11 2014 - Medial View - Right



March 28 2014 - Medial View - Left



April 11 2014 - Medial View - Left

May 8 2014 - Medial View - Right

June 6 2014 - Medial View - Right

May 8 2014 - Medial View - Left

June 6 2014 - Medial View - Left

DISCUSSION

Study Limitations

During this study, there were a few factors that may have affected the research and results discovered. One impediment is the treatment plan compliance. The patient neglected the hydrotherapy portion of the prescribed homecare until April 12 2014 when full compliance was met and maintained. The patient experienced an increase in pain in the beginning of the study

period due to prolonged homecare stretching. After shortening the time of the stretching done as homecare, pain was greatly reduced. The results may have been different had the patient performed the homecare as prescribed. The patient also experienced other health concerns that, at times, minimally hindered the ability to comply. The appointment schedule was also skewed due to the patient's other health concerns and a clinic closure for a statutory holiday. Some of the assessment could have been more accurate, such as the Q-Angle; the results were fairly consistent, but far from normal. This may be because the patient had musculoskeletal abnormalities or the procedure of the test was executed or collected incorrectly, by the application or the therapist. It would have been beneficial to have a more visible ruler included with the pictures to have the ability to clearly measure any changes from assessment to assessment.

The amount of examinations were vast, and it may have been more beneficial to narrow them down, to be more specific. There was a lot of data to analyse and much of the information was irrelevant to the pathology, or static throughout the study. More preparation prior to the study would have decreased the time taken to assess the patient, allowing more treatment time. The gait videos obtained were a good source of outcome measures, however the patient's arms were inconsistent, and occasionally held on her hips, instead of the natural swing, in the gait cycle between assessments; this would affect the normal gait cycle.

The amount of treatment techniques were also quite vast and made it difficult to try to conclude the reasons behind the positive results. Which techniques used that were effective is unclear compared to the techniques that may have had no effects at all. The patient also had a prior professional relationship with the therapist which may have created an opportunity for

transference. The patient was previously treated for neck and back pain prior to the study period. Any previous treatment plan was put on hold for the duration of the study.

A full re-assessment of the original health forms should have been completed to see if there were any changes in the other unrelated, diagnosed health conditions or medication doses that were originally presented in the initial assessment.

Findings

Overall the treatments were effective for PF, as well as other musculoskeletal abnormalities presented by the patient at the start of the study. The primary goals of treatment to decrease pain and increase the patient's ability to perform physical activity were met by the end of the study period. Results of the examinations demonstrated many improvements to special tests, local palpable pain, swelling, and mobility. More research is needed on specific interventions without integration of other modalities, to argue the effectiveness of manual therapy as treatment for PF. The results of this study, in terms of general physical therapy, concurred with the other research reviewed. This study was more specific with which manual techniques were used, but further research is needed to make the results of this study conclusive.

Comparing the pictures taken at each full assessment revealed major changes in ankle swelling, weight distribution at the ankles, and joint stability. From the initial assessment, a large amount of swelling was apparent. The cause was unknown but thought to be possible side effects of the prescription medications the patient was taking on a daily basis. The pictures in the posterior view, shows the vast improvement of the swelling, gradually throughout the study period. This may be a result of the increased activity and therefore increased circulation, as well as the treatments that increased the ROM.

The patient complained of foot pain on the left more than the right, and based on the pictures of the medial views, of left and right, the different amounts of natural arch support are displayed. The left side notably has much more moderate symptoms of pes planus which could be one of the main causes of the PF for this patient. Although gait was used as an outcome marker, it was not analysed during the study to alter treatment. Gait analysis showed major right ankle instability, right hip circumduction, and minimal heel-off/toe-off movement bilaterally, after the initial assessment. Gait changes throughout the study were subtle but small improvements were made such as the feet facing more anterior, right ankle stability, and equal weight distribution on lateral edges of feet with a decrease in pronation. The overall improvement in the gait biomechanics may play a role in the positive changes in the functionality and decrease in constant pain. Although it is unable to know for certain, improvements in biomechanics during gait may have been beneficial in the pain previously experienced in the low back and right knee.

It could be presumed that the patient's causes of PF were from poor gait biomechanics, chronic ankle swelling, right knee pain and an fallen arch on the left foot. After treatment, compensating structures had been stretched and strengthened where necessary in order to help support these discrepancies, thus decreasing most signs and symptoms.

Plantar fasciitis is a common condition that can be effectively treated with massage therapy and appropriate homecare intervention, as a primary form of treatment. Many intervention options are under researched, and results are inconclusive of the effectiveness when treating this degenerative pathology. This study demonstrated that the integration of massage therapy and homecare including hydrotherapy, stretching, and strengthening exercises can address tissue adaptations to musculoskeletal abnormalities provoked by plantar fasciitis. This

approach to treatment resulted in resolution of most signs and symptoms originally presented and decreased foot pain to a level of high satisfaction of the patient within 6 weeks of treatment in the study period.

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APPENDIX A: OUTCOME MEASURE FORMS CREATED

Pain Scale Questionnaire

Sleeping Habits

- □ I get no pain in bed
- □ I get pain in bed, but it doesn't prevent me from sleeping well
- □ Because of my pain, my normal night's sleep is reduced by less than one-quater
- □ Because of my pain, my normal night's sleep is reduced by less thank one-half
- □ Because of my pain, my normal night's sleep is reduced by less than three-quaters
- □ Pain prevents me from sleeping at all

Standing

- □ I can stand as long as I want without pain
- □ I have some pain while standing, but it doesn't increase with time
- □ I can not stand for longer than one hour without increasing pain
- □ I can not stand for longer than half an hour without increasing pain
- □ I can not stand for longer than ten minutes without increasing pain
- □ I avoid standing because it increases the pain right away

Pain Intesity

- □ The pain comes and goes and is very mild
- □ The pain is mild and does not vary much
- □ The pain comes and goes and is moderate
- □ The pain is moderate and does not vary much
- □ The pain comes and goes and is severe
- □ The pain is severe and does not vary much

Walking

- □ Pain does not prevent me from walking any distance
- □ Pain prevents me from walking more than 60 minutes on flat terrain
- □ Pain prevents me from walking more than 30 minutes on flat terrain
- □ Pain prevents me from walking more than 10 minutes on flat terrain
- □ I can only walk while using a cane or crutches
- □ I am in bed most of the time and have to crawl to the washroom

Sitting

- □ I can sit in any chair as long as I like without pain
- □ I can only sit in my favorite chair as long as I like without pain
- □ Pain prevents me from sitting for more than 60 minutes without pain
- □ Pain prevents me from sitting for more than 30 minutes without pain
- □ Pain prevents me from sitting for more than 10 minutes without pain
- □ Pain prevents me from sitting at all

Social Life

- □ My social life is normal and gives me no pain
- □ My social life is normal, but pain gradually increases over time
- □ Pain has no significant effect on my social life apart from limiting my more physical activities Ex: Dancing
- □ Pain has restricted my social life and I do not go out very often
- □ Pain has restricted my social life to my home
- □ I have hardly any social life because of pain

Changing Degree of Pain

- □ My pain is rapidly getting better
- □ My pain fluctuates, but overall is definitely getting better
- □ My pain seems to be getting better, but improvement is slow at present
- □ My pain is neither getting better or worse
- □ My pain is gradually getting worse
- □ My pain is rapidly getting worsening

Rate your overall foot pain on a scale of 1 - 10. Please circle one of the following:

No Pain 1 2 3 4 5 6 7 8 9 10 Worst pain I ever felt

Exercise Diary **Dates:**

Monday

Type	Onset of Pain	Total Time	Reason
Type	Onset of Pain	Total Time	Reason
Type	Onset of Pain	Total Time	Reason

Tuesday

Type	Onset of Pain	Total Time	Reason
Type	Onset of Pain	Total Time	Reason
Type	Onset of Pain	Total Time	Reason

Wednesday

Type	Onset of Pain	Total Time	Reason
Type	Onset of Pain	Total Time	Reason
Type	Onset of Pain	Total Time	Reason

Thursday

Type	Onset of Pain	Total Time	Reason
Type	Onset of Pain	Total Time	Reason
Type	Onset of Pain	Total Time	Reason

Friday

Type	Onset of Pain	Total Time	Reason
Type	Onset of Pain	Total Time	Reason
Type	Onset of Pain	Total Time	Reason

Saturday

Type	Onset of Pain	Total Time	Reason
Type	Onset of Pain	Total Time	Reason
Type	Onset of Pain	Total Time	Reason

Sunday

Type	Onset of Pain	Total Time	Reason
Type	Onset of Pain	Total Time	Reason
Type	Onset of Pain	Total Time	Reason

Weekly Notes:

APPENDIX B: PATIENT FEEDBACK LETTER

Email from patient on June 10 2014 in regards to overall impression of the case study.

I agreed to be involved in a case study for Plantar Faciitis, a very painful foot condition. Prior to the case study I had recently been on disability leave from work for over 3 years for severe clinical depression and chronic migraine headaches. These conditions contributed to the onset of other health problems, including plantar Faciitis. During the 3 years I experienced sleep disorder, poor diet, lack of exercise and significant weight gain among other symptoms/problems. I hoped that my involvement in the case study might bring some relief to the pain I was experiencing so that I could increase my physical activity and ultimately address all of my current health issues. For 6 weeks I received massage therapy twice per week as well I was given a home care program that included stretching, strengthening exercises and hydro therapy. Initially I found my therapy and home care to be somewhat painful but soon noticed the symptoms begin to ease. As I progressed through the case study I found great relief in the pain and in my ability to stand and/or walk for longer periods of time as well as physical activity in general much improved. Also worth mentioning is the relief from pain I have been experiencing in one of my knees and my lower back. Now that the case study has ended I still follow my stretching, strengthening and hydro therapy routine and am experiencing little to no foot pain on a daily basis allowing me to take on my other health problems which are also improving significantly. Unfortunately I still experience the migraine headaches and this is affected by vigorous exercise but I feel overall that the case study has most positively affected my quality of life. I am very happy that I participated in this study and feel very fortunate for the benefits I received in doing so.