Evidence-based Evaluation and Treatment of a Patient with Plantar Heel Pain: A Case Report

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ABSTRACT

Background: Plantar heel pain (PHP) is a common musculoskeletal complaint treated by physical therapists. Though clinical practice guidelines exist for evaluation and treatment of PHP, a dearth of case-specific studies describe the clinical application of these guidelines. In this case report, the various physical, pathoanatomical, and social features of PHP are presented with a multimodal, evidence-based treatment approach. **Description:** The patient is a 63-year-old female presenting with a complaint of chronic unilateral plantar heel pain. The initial onset of symptoms was 6 months prior to the examination. Using recent clinical practice guidelines, orthopedic physical therapy management was applied. **Outcome:** After 7 visits, the patient reported significant improvement in pain and function, and returned to her baseline activity. These improvements were maintained or improved at 7-month follow-up. **Conclusion:** A multimodal approach informed by the best available evidence was successfully used for management of PHP.

Key Words: clinical reasoning, exercise, plantar fasciitis, manual therapy

BACKGROUND

Plantar fasciitis is a common musculoskeletal impairment that results in heel and arch pain in both the athletic population[1] and the general population.[2] Plantar fasciitis involves a degenerative irritation[3] of the plantar fascia that leads to heel and arch pain, primarily after a period of nonweight bearing.[4] Roughly 2 million Americans suffer from plantar fasciitis, and approximately 10% of the population will seek treatment for it in their lifetime.[5] An understanding of the contributing factors involved in the pathomechanics can aid clinical decision-making for conservative intervention.

The plantar fascia is a flat band of dense connective tissue with a proximal attachment on the medial calcaneal tuberosity. The fascia fans out into 5 distinct strands at the mid-metatarsal level as it extends to the distal aspect of the forefoot where it attaches to the plantar skin, the plantar plate at the base of the proximal phalanges, and ligaments of the metatarsophalangeal (MTP) joints.[2] The fascia can be anatomically divided into 3 bands: the medial, the lateral, and the central. The central band is considered the most important in terms of function and structure.[4] The plantar fascia has a variety of functions in the foot. The fascia supports the medial longitudinal arch of the foot during weight bearing. During weight bearing, the tibia internally rotates and the arch lengthens and flattens. The plantar fascia resists this arch motion and helps to maintain arch height. The arch is also supported by the windlass mechanism, first described by Hicks.[6] In short, dorsiflexion of the toes in weight bearing causes the plantar fascia to wind tighter around the metatarsal heads. This results in increased tension in the plantar fascia that in turn increases the height of the arch. The activation of the windlass mechanism stabilizes the arch to prepare the foot for propulsion during ambulation.[4] The intrinsic muscles of the feet can reduce loading of the plantar fascia and are also active during the propulsion phase of gait.[4] Extrinsic muscles of the foot including the flexor hallucis longus, flexor digitorum longus, peroneus longus and brevis, and posterior tibialis also have tendons that enter the plantar arch and provide additional truss support. These biomechanical implications highlight potential identifying factors and treatments of plantar fasciitis.

Common etiological factors in the development of plantar fasciitis are those associated with mechanical overload of the plantar fascia, and can be delineated into intrinsic and extrinsic variables.[4] Intrinsic factors include decreased height of the medial longitudinal arch, increased rate of tissue loading, or both.[4] Individuals with a greater body mass index (BMI) transmit a greater tibial loading force into the dorsal talus at the convex aspect of the medial longitudinal arch of the foot. Equal and opposite ground reaction force is imposed on the plantar aspect of the foot at both ends of the longitudinal arch at the calcaneus and the MTP joints of the forefoot. The increased 3-point bending of the foot places greater tensile stress on the plantar fascia. This mechanism describes why individuals with a greater BMI experience greater tensile stress within the plantar fascia during ambulation.[7] Prichasuk, in a heel pad thickness and plantar heel pain correlation study reported, that individuals with a greater BMI were more likely to experience plantar heel pain compared to those with lower BMI.[8]

Individuals with a flattened, elongated arch known as pes planus place greater tensile stress on the plantar fascia.[9] Excessive subtalar pronation and insufficient talocrural dorsiflexion are also intrinsic factors that place greater tensile stress on the plantar fascia. Studies by Irving et al[10] and Cornwall and McPoil[11] support that individuals with a pronated foot including subtalar pronation posture were more likely to develop plantar fasciitis. Solan et al[12] reported that shortening and tightness of the plantar flexor muscles, such as the gastrocnemius, imposed increased strain on the Achilles tendon and the plantar fascia. Additionally, Riddle et al[13] determined reduced ankle dorsiflexion and obese BMI levels were each independent risk factors for developing plantar fasciitis. For normal ambulation, 10° of ankle dorsiflexion with the knee extended is required. If dorsiflexion is limited, excessive subtalar pronation and midfoot dorsiflexion may be used as a compensatory mechanism to allow forward progression of the leg, thus increasing the stress on the plantar fascia. Additionally, the presence of forefoot varus may drive foot pronation and be a factor in the development of plantar fasciitis. With the distal aspect of the foot inclined towards the midline, the lateral ground reaction force may cause an eversion moment that increases foot pronation, thereby increasing the tensile stress imposed on the plantar fascia.[14]

The extrinsic factors that contribute to the development of plantar fasciitis include improper footwear or a rapid increase in the frequency, duration, or intensity of weight-bearing activities. Footwear that lacks ample cushioning and arch support can cause increased stress to the plantar fascia.[15] Females may be at even greater risk given the popularity of women's footwear that does not provide cushioning or arch support.[16] Finally, a drastic increase in the frequency, duration, or intensity of an activity that requires repetitive loading of the foot can lead to fatigue of the muscles that support the arch, thereby overstraining the plantar fascia.[13]

Conservative treatment is the first step for treating plantar fasciitis and generally includes multiple interventions such as plantar fascia and triceps surae stretching,[17] ankle dorsiflexion night splints,[18] anti-pronation taping,[19] improved footwear,[20] use of foot orthoses,[21] and manual physical therapy to increase ankle dorsiflexion.[5] Wolgin et al[22] reported 82 of 100 patients treated conservatively for plantar fasciitis had good long-term results. In this study, the conservative treatments included triceps surae and plantar fascia stretching, custom orthoses, nonsteroidal anti-inflammatories (NSAIDs), injections, heat, ice, and night splints.[22] Similarly, Davis et al reported favorable outcomes following conservative treatment that consisted of relative rest, NSAIDs, heel cushions, Achilles tendon stretching, and injections in 89.5% of patients at an average follow-up of 29 months.[23] In the majority of cases, conservative treatment leads to resolution of symptoms in less than 12 months.[24]

If conservative treatment fails, additional treatment options include corticosteroid injection and surgery. Corticosteroid injection for the plantar fascia remains controversial, with numerous reported instances of plantar fascia rupture and additional long-term side effects that can be difficult to treat.[25] Surgical intervention involves partial to complete resection of the plantar fascia and the removal of any existing heel spurs.[26] Complete resections lead to more pronounced biomechanical consequences, such as loss of medial longitudinal arch height, decreased arch stiffness, the possibility of developing midfoot osteoarthritis in the future, and increase in pes planus foot position. Therefore, individuals with pronounced pes planus may not benefit from surgical resection. Otherwise, positive outcomes have been reported in both short- and long-term follow-up.[27] A recent update of Clinical Practice Guidelines (CPGs) provides evidence based examination procedures and interventions for the conservative treatment of plantar fasciitis.[5] The purpose of this case report is to describe the application of evidence from the CPGs to examination findings, clinical reasoning, and conservative treatment for a patient with plantar fasciitis.

CASE DESCRIPTION

The patient was a 63-year-old female who worked as a housing program coordinator and was required to wear dress shoes while at work. She was diagnosed with plantar fasciitis of the left foot by her primary care physician and was prescribed stretches for ankle dorsiflexion, intrinsic foot muscle strengthening, and advice to roll her foot on a frozen water bottle. At her 6-month follow-up appointment, her symptoms had not resolved and she was referred to outpatient physical therapy. At the physical therapy evaluation, the patient described symptoms as a sharp left heel pain when taking the first steps in the morning or after long periods of nonweight bearing. The patient was morbidly obese, with a BMI of 41.16 kg/m^2. She had not experienced any foot pain previously and did not report any sudden increase in her activity level when her symptoms began. Aggravating factors included walking or standing for longer than 30 minutes and participating in Zumba exercise classes. At the time of evaluation, she was not able to participate in exercise classes and was limited with walking longer distances throughout her work day due to her heel pain. The patient noted that wearing tennis shoes seemed to help decrease her heel pain but using simple store bought plantar fasciitis insoles had no effect on her heel pain. She rated her current pain as 2/10 on the 11-point Numerical Pain Rating System (NPRS). She reported her worst pain as 8/10 in the mornings and her least pain was 0/10. No diagnostic medical imaging had been performed on the patient's left foot. The patient's goals for physical therapy were to decrease her left heel pain, improve her standing and walking tolerance, and participate in her Zumba exercise class.

The patient's review of systems to identify red flag symptomology that might suggest cancer or systemic infection was negative. She denied recent bowel or bladder changes, history of cancer, night pain, saddle anesthesia, recent weight loss, nausea, vomiting, or fever.[28] Following the subjective interview, a physical examination was performed. Differential diagnoses included plantar fasciitis, calcaneal stress fracture, tarsal tunnel syndrome, proximal plantar fibroma, and fat pad atrophy throughout the examination procedure.

SELF-REPORTED OUTCOME MEASURES

The patient completed the Lower Extremity Functional Index (LEFS) to measure her perception of heel pain's influence on her ability to perform activities of daily living (ADLs). The LEFS is a 1-page questionnaire that consists of 20 questions, with lesser scores demonstrating greater disability. A recent systematic review established the LEFS as having excellent psychometric properties, including test-retest reliability (ICC = 0.85 – 0.99) and responsiveness (effect sizes > 0.8).29 The minimal clinically important difference (MCID) for the LEFS has been reported as 9 points in patients with lower extremity musculoskeletal conditions.[29] The patient completed the LEFS with a score of 41/80 on initial examination.

Additionally, the patient completed the Foot and Ankle Ability Measure (FAAM) to assess physical performance affected by her foot pain. The FAAM consists of an ADL Subscale with 21 items and a Sports Subscale with 8 items that are each scored on a Likert system. Greater scores represent an increased level of physical ability. Each subscale asks the patient to rate their current level of function subjectively from 0 to 100%, with 100% representing their level of function prior to their foot or ankle problem. The FAAM has excellent test-retest reliability for the ADL (ICC = 0.87) and the Sports (ICC = 0.89) subscales.[30] The MCID for the FAAM has been reported as 8 points for the ADL Subscale and 9 points for the Sports Subscale.[30] The patient completed the FAAM with an ADL score of 76.2% and self-rated ability of 80%. Her sports score was 31.3% with a self-rated ability of 50%. The Sports Subscale of the FAAM was administered due to her goal of returning to Zumba exercise classes.

PHYSICAL EXAMINATION

A body weight squat was used as a functional movement assessment, which revealed bilateral genu valgus and bilateral subtalar joint pronation that was greater on the left foot compared to the right. The patient was unable to balance for more than one second on her left foot due to pain. Gait analysis revealed an antalgic gait favoring her right side and overt pronation of her left foot. She was positioned in prone to test for triceps surae extensibility by passively dorsiflexing her ankle. Substantial soft tissue restriction limited dorsiflexion of the left ankle. Significant forefoot varus of the left foot was visualized in this position. She exhibited decreased active ankle dorsiflexion range of motion

(ROM) of 0° bilaterally and passive dorsiflexion range at 2° bilaterally. Ankle dorsiflexion was measured with the knees extended to mimic the functional position during gait. Her ankle plantar flexion, inversion, and eversion ROM measurements were within normal limits for each ankle.

Plantar fibroma was included in the differential diagnoses based on the location of pain. Palpation of the plantar aspect of the calcaneus to the mid-tarsal region of the foot was performed to identify any thickened nodules.[31] No nodules were present. Palpation revealed tenderness of the medial plantar aspect of her calcaneus. Calcaneal fracture was a differential diagnosis and was screened using the Ottawa Ankle Rules. The patient was not tender to bony palpation at the base of the fifth metatarsal or at the navicular. She could bear weight on her left foot while ambulating in the clinic. Therefore, a calcaneal fracture was ruled out.[32] Her lower extremities and ankles were tested for muscle strength using manual muscle testing procedures. She scored 5/5 globally with this testing.

Tarsal tunnel syndrome was included in the differential diagnosis due to complaints of medial plantar pain and worsening of symptoms during weight-bearing activities.[33] The tarsal tunnel test was performed to rule out tarsal tunnel syndrome.[34] In sitting, the patient's ankle was maximally dorsiflexed and everted with full extension of all 5 toes. This position was maintained for 10 seconds while the tarsal tunnel was percussed repeatedly. Her symptoms were not reproduced, nor did the patient experience any local tenderness. The Windlass Test was performed in weight bearing to rule in plantar fasciitis.[35] She stood on a 4-inch box with the head of the first left metatarsal head resting on the box with the edge of the box aligned with the first MTP joint line. She was instructed to bear weight equally through each foot as the therapist passively extended the first MTP joint. Her heel pain was reproduced during the Windlass Test on her left foot. Finally, the Foot Posture Index (FPI) was used to identify the contribution of pronated foot posture on the patient's chronic heel pain.[10] She scored a +10 on the FPI (Table 1), indicating significant pronation of the left foot that could exacerbate plantar fasciitis.[10] Figures 1-6 depict the patient's specific postural elements that were scored on the 6 criteria for the FPI.

CLINICAL WORKING DIAGNOSIS

Following the subjective history and the objective physical examination, plantar fasciitis of the left foot was established as a working diagnosis. Subjective reports consisting of heel pain with the first step in the morning, after a period of inactivity, and after prolonged weight bearing supported this diagnosis.[5] Objective findings including tenderness to palpation of the insertion of the plantar fascia at the medial calcaneal tubercle, a positive Windlass Test, limited active and passive ankle dorsiflexion ROM, a greater FPI score, and a greater BMI, further supported this clinical working diagnosis.[5] The absence of a dense nodule at the mid-tarsal level of the plantar aspect of the foot suggested that plantar fibroma could be ruled out.[31] A negative tarsal tunnel test suggested that tarsal tunnel syndrome could likely be ruled out.[34] Fat pad atrophy was ruled out due to the absence of complaints of pain at rest, pain at night, and bilateral foot pain.[36]

INTERVENTIONS

Based on the working diagnosis and the lack of formal conservative treatment to date, physical therapy intervention was deemed appropriate. To address the identified soft tissue restrictions, the patient was prescribed a stretching routine that targeted the posterior muscles of the leg, Achilles tendon, and plantar fascia of the left foot. She was instructed to face a wall and step forward with her right foot while leaving her left knee fully extended to promote more effective stretching of the gastrocnemius muscle. Importantly, the plantar fascia was stretched in this position by placing a small towel beneath the left toes to activate the windlass mechanism (Figure 7). She was instructed to keep both feet facing forward and to lean into the wall with her arms while bending her front knee until she felt a gentle stretch in her posterior leg and the plantar aspect of her foot. She was instructed to hold this stretch for 3 sets of 45 seconds, 3 times daily. A second stretch was prescribed as described above, except the back leg was to remain bent as the patient leaned into the wall to promote more effective stretching of the soleus muscle. The patient was also prescribed a stretch to be performed in bed before she took her first step in the morning. She was instructed to assume a long sitting position, wrap a towel around the ball of her foot, and pull her forefoot towards her while keeping her knee straight. This stretch was to be held for 3 sets of 30 seconds each morning. Additionally, the patient was prescribed a plantar fasciitis night splint to be worn every night (Figure 8).

Instrument assisted soft tissue mobilization and cross friction massage were performed to areas of soft tissue restriction at the left medial head of the gastrocnemius muscle and directly to the plantar fascia.[37] Both Looney et al[37] and Cleland et al[38] demonstrated the benefits of soft tissue work in these areas to decrease pain and improve function in individuals with plantar fasciitis. To improve the patient's talocrural dorsiflexion restriction, a grade IV anterior-to-posterior talocrural joint mobilization was performed during the first 4 visits. The patient was positioned in supine as the therapist used one hand to stabilize the lower leg and grasped the anterior, medial, and lateral talus with the other hand to apply an anterior-to-posterior force to the talus as the therapist passively dorsiflexed the ankle with his thigh (Figure 9).[38] Additionally, a joint mobilization with the patient in half kneeling was used to improve her left ankle dorsiflexion. The patient knelt with her right knee on a pillow and assumed a lunge position with her left hip and knee flexed to 90° with her left foot flat on the ground. The therapist applied a stabilizing anterior-to-posterior force over the anterior talus while the patient shifted her weight forward into painfree ranges of ankle dorsiflexion and the therapist imposed an anterior glide of the distal leg (Figure 10). This was repeated for 3 sets of 10 repetitions.

From a mechanistic view, intrinsic plantar muscles decrease the stress placed on the plantar fascia during mid-stance and propulsion of the gait cycle by providing dynamic support to the medial longitudinal arch of the foot.[38-40] The FPI, administered with the patient in standing, and gait analysis revealed the patient had a flattened arch. Therefore, strengthening of the intrinsic plantar muscles of her foot was prescribed to reduce stress on the plantar fascia.[39] A hand towel was placed on the ground beneath the patient's foot. The patient was instructed to repeatedly pull the towel towards her heel using her toes while keeping her foot on the ground. This was performed for 3 sets of 10 repetitions. At the second visit, a trial of anti-pronation taping using kinesiotape was performed on the left foot. The skin was cleaned and free of oils or lotions. A strip of approximately 5 inches of kinesiotape was cut with the ends rounded off to increase wear time.[41] The tape was placed beginning on the dorsum of the left foot, wrapped and circled laterally around the left foot to resist subtalar pronation using 75% tension. The tape was anchored by finishing the wrap around the ankle at the level of the medial malleoli. The patient wore the tape for approximately 5 days and reported

Table. Foot Posture Index (FPI).[53] Underlined items represent the patient's left foot score for each item (+10 total).

	-2 points (supinated)	-1 point	0 points (neutral)	+1 points	+2 points (pronated)
Talar Head Palpation	Talar head palpable on lateral side/but not on medial side	Talar head palpable on lateral/ slightly palpable on medial side	Talar head equally palpable on lateral and medial side	Talar head slightly palpable on lateral side/palpable on medial side	Talar head not palpable on lateral side/but palpable on medial side
Supra and infra lateral malleoli curvature	Curve below the malleolus either straight or convex	Curve below malleolus concave, but flatter/more than the curve above malleolus	Both infra and supra malleolar curves roughly equal	Curve below the malleolus more concave than curve above malleolus	Curve below the malleolus markedly more concave than curve above malleolus
Calcaneal frontal plane position	More than an estimated 5° inverted (varus)	Between vertical and an estimated 5° inverted (varus)	Vertical	Between vertical and an estimated 5° everted (valgus)	More than an estimated 5° everted (valgus)
Bulging in the region of the TNJ	Area of TNJ markedly concave	Area of TNJ slightly, but definitely concave	Area of TNJ flat	Area of TNJ bulging slightly	Area of TNJ bulging markedly
Congruence of medial longitudinal arch	Arch high and acutely angled towards the posterior end of the medial arch	Arch moderately high and slightly acute posteriorly	Arch height normal and concentrically curved	Arch lowered with some flattening in the central position	Arch very low with severe flattening, arch contacts ground
Abduction/ adduction of forefoot on rear foot	No lateral toes visible. Medial toes clearly visible	Medial toes clearly more visible than lateral	Medial and lateral toes equally visible	Lateral toes clearly more visible than medial	No medial toes visible. Lateral toes clearly visible
Abbreviation: TNJ, talonavicular joint					

no decrease in symptoms. Therefore, anti-pronation taping was not used during the remainder of the treatment sessions. After 5 weeks of treatment, the patient was fitted for custom orthoses by another physical therapist in the same clinic. Sulcus length foot orthoses with increased arch fill were fitted to the patient. Due to the patient's need to wear dress shoes at work, the orthoses were not full length. Ideally, medial forefoot posting would have been added to the full-length orthoses to address her forefoot varus. Education on wearing supportive footwear that could accommodate the custom orthoses was provided at this time.

The patient's home exercise program throughout treatment included the following:

- triceps surae/plantar fascia stretching for 3 sets of 45 seconds, 3 times per day;
- seated towel stretches before first step in the morning, 3 sets of 30 seconds, every morning;

Figure 1. Observation of talar head position. Small circle indicative of the lateral talar head position and the larger circle indicates the weight-bearing position of the talar head medially.

Figure 2. Observation of the supra and infra lateral malleolar curvature of the involved left lower extremity in weight bearing. A more acute curve is visualized inferior to the lateral malleolus due to the abduction of the foot and eversion of the calcaneus.

Figure 3. Observation of the calcaneal frontal plane position. More than an estimated 5° everted (valgus).

Figure 4. Observation indicating bulging in the region of the talonavicular joint represented by the circled area. Rearfoot pronation demonstrated by adduction of the head of the talus.

Figure 5. Observation of the height and congruence of the medial longitudinal arch of the involved lower extremity. A low arch is observed with severe flattening.

- towel scrunches for 3 sets of 10 repetitions, 1 time per day;
- wearing the night splint every night; and
- wearing the custom foot orthoses with supportive footwear during any weight bearing.

OUTCOMES

The patient was seen for a total of 7 visits over the course of 7 weeks. At 2 weeks follow-up, she described her morning foot pain as greatly reduced after wearing the night splint consistently. At discharge from physical therapy, the patient showed improvements on the NPRS, the LEFS, the FAAM, and subjective performance of daily activities. Specifically, the patient reported use of the custom orthoses decreased pain with walking from 8/10 to 0/10 on the NPRS. Her LEFS score improved from 41/80 to 73/80 at discharge from physical therapy. Her FAAM score improved from 76.2% to 87.5% for the ADL Subscale and from 31.3% to 50% for Sports Subscale and her self-rated ability on the FAAM also improved from 80% to 90% for ADLs and from 50% to 80% for sports. An MCID was achieved on every patient-reported measure. Her left ankle active dorsiflexion ROM improved from 0° at evaluation to 5° at discharge. The patient was able to perform yoga in her home and was able to walk for more than 30 minutes at a time without any increase in her left heel pain. Overall, she reported a subjective improvement of "at least 90%" and demonstrated independence with her home exercise program.

At 7-month follow-up, patient reported outcomes remained favorable. Her NPRS score remained 0/10 with minimal flare ups of left heel pain that returned to 0/10 after performing her stretches. Her LEFS score improved from 73/80 to 75/80 and her FAAM ADL and Sports Subscales improved to 97.6% and 84.4%, respectively. Her self-rated ability on the ADL and Sports Subscales also improved to 95% and 90%, respectively. The patient had been able to continue practicing yoga without heel pain. It should be noted the patient was not participating in activities that required running or jumping. She completed the outcome measures based on her perceived ability to complete the activity items listed.

DISCUSSION

This case study describes the examination, clinical reasoning, and conservative treatment approach for a patient with heel pain caused by plantar fasciitis. Secondary to the complexity of multiple contributing factors to the diagnosis of heel pain, a thorough subjective interview and objective physical examination are needed to differentiate plantar fasciitis.[36] Conservative treatment should be the first line treatment in managing plantar fasciitis. Wolgin et al[22] and Davis et al[23] have demonstrated conservative treatment leads to good outcomes for most patients. The current CPG for the treatment of plantar fasciitis[5] with strongest evidence level (A) were informative in treatment considerations. The primary interventions used for this patient had grade A-level evidential support from the CPG including soft tissue and joint mobilization, targeted calf and plantar fascia stretching, the use of a night splint, the fabrication of a custom foot orthosis, and taping.

Manual therapy for plantar fasciitis is highly recommended by the CPG. Cleland et al showed patients with heel pain who received manual therapy including anterior to posterior ankle mobilizations, as well as soft tissue mobilizations of the plantar fascia and triceps surae, had better functional outcomes at 4-week and 6-month follow-up.[38] Gastrocnemius muscle tightness can affect ankle dorsiflexion ROM because it crosses the knee and the ankle joint. The gastrocnemius muscle is at its longest length and thus at its maximal tension with the knee in full extension just prior to heel-off. Knee flexion reduces the influence of the gastrocnemius muscle on ankle dorsiflexion as the length of the muscle is shortened. Baumbach et al[42] reported gastrocnemius muscle tightness does not affect ankle dorsiflexion at 20° of knee flexion. The patient's ankle dorsiflexion was only measured with the knee in full extension. A comparison of ankle dorsiflexion ROM with the knee extended versus flexed to 20° may have provided a more specific choice for intervention targeting joint mobilizations versus soft tissue mobilizations. Future research should seek to distinguish the difference between soft tissue- and joint-related ankle ROM restrictions.

The CPG cites numerous studies that suggest stretching of the triceps surae and the plantar fascia are beneficial. Rompe et al demonstrated that plantar fascia-specific stretching improved foot function at 2- and 4-month follow up.[17] Sweeting et al determined that plantar fascia-specific stretching may be more beneficial than Achilles tendon stretching only.[43] Digiovanni et al described a distinct improvement in pain and function of patients who performed both Achilles tendon and plantar fascia-specific stretching versus only plantar fascia stretching over their 16-week course of care.[44] Often, these components are stretched using different exercises. In this case, a novel stretching approach simultaneously addressed tightness of the triceps surae, the Achilles tendon, and the plantar fascia (see Figure 7). It is possible this stretch could lead to greater patient compliance as it reduces the amount of time spent performing home exercises. Although other interventions were used, stretching is the most cost effective and is an active treatment strategy the patient can incorporate throughout the day.

The CPG recommends patients who consistently have pain with the first step in the morning should use a night splint for 1 to 3 months.[5] Sheridan et al demonstrated night splints that provide a low load, prolonged ankle dorsiflexion stretch led to greater reductions in plantar fascia-related pain compared to those who did not use the night splints.[18] Lee et al used night splints in addition to foot orthoses and reported decreased pain at 2- and 8-week follow-up compared to use of foot orthoses alone.[45] Beyzadeoğlu et al reported a significant improvement in pain and function in those who used a night splint versus those who did not after 8 weeks.[46]

The use of prefabricated versus custom foot orthoses for plantar fasciitis is somewhat controversial. Hawke et al[47] found that custom orthoses were no more beneficial than prefabricated foot orthoses in terms of pain and function. Uden et al, however, demonstrated that custom foot orthoses led to reductions in pain and improvement in overall function for patients with plantar fasciitis.[21] A review by Hume et al reported moderate improvements of pain and function in favor of prefabricated versus sham foot orthoses.[48] The same review also found that custom semi-rigid foot orthoses had moderate positive effects compared to anti-inflammatories and stretching.[48] Prefabricated orthoses cost less and are easier to access for most patients. Since prefabricated orthoses provided no relief for this patient, she was fitted with custom sulcus length foot orthoses with increased arch fill. Given the patient's significantly pronated foot posture, the custom orthoses likely provided the external support needed to offload the tensile stress in her painful plantar fascia. The CPG recommends either option and does not state a preference between the two. Further studies are needed to determine if custom foot orthoses could serve as an improvement in care when prefabricated foot orthoses fail.

The CPG recommends that anti-pronation taping be used for immediate pain relief of up to 3 weeks.[5] Van Lunen et al demonstrated an immediate decrease in pain with walking and jogging using anti-pronation taping.[19] A systematic review by Landorf and Menz found strong evidence that taping reduced pain at 1 week and was of additional benefit when combined with stretching.[49] Another systematic review by van de Water and Speksnijder found taping reduced first step pain compared to no taping and overall pain reductions after 1 week compared to sham taping.[50] Tsai et al reported elastic taping of the gastrocnemius and plantar fascia led to decreased pain after one week compared to ultrasound and electrotherapy alone.[51] A trial of anti-pronation taping using kinesiotape was not effective in reducing the patient's heel pain with walking. The therapist had limited experience with this style of taping, which may have played a role in the absence of this treatment for the patient.

The evidence is weak at grade C in the CPG for the use of footwear such as rocker-bottom shoes and a rotation of shoes for those who work on their feet. Rocker-bottom shoes lessen the loading of the plantar aponeurosis.[52] Fong et al found that combining a rocker-bottom sole with foot orthoses immediately reduced plantar heel pain significantly more than using either intervention in isolation.[20] Sullivan et al determined that females may face greater difficulty with selection of footwear that is supportive of plantar heel pain.[16] Due to the dress code at the patient's work, she was required to wear dress shoes. The patient was educated on footwear selection that would accommodate her foot orthoses that also met her work's dress code. Changing her shoes to work-approved athletic shoes appeared to have been the most beneficial for the patient in terms of both pain reduction and improvement of function, as it allowed her to consistently wear her foot orthoses.

Figure 6. Observation of abduction of the forefoot on the rearfoot for the involved left lower extremity.

Figure 7. Demonstration of the stretch for the involved posterior left leg muscles, Achilles tendon, and the plantar fascia with a towel roll under the toes so that the metatarsophalangeal joints are in extension to take advantage of the windlass mechanism.

Intrinsic foot strengthening is not specifically recommended in the CPG. Cleland et al demonstrated strengthening of the plantar intrinsic muscles led to a reduction of heel pain.[38] Cheung et al identified greater atrophy of the intrinsic muscles in patients with plantar fasciitis compared to asymptomatic patients.[39] The patient was instructed in strengthening of the intrinsic muscles to improve dynamic arch support and decrease tensile stress on the plantar fascia during weight bearing.

CONCLUSION

The highest quality research regarding conservative treatment for heel pain caused by plantar fasciitis has been recently updated.[5] A combination of evidence-supported conservative interventions from the recent update to the CPG for plantar fasciitis are likely more effective than any one intervention on its own. This case highlights the importance of performing a thorough subjective history and detailed examination of the foot to identify a patient's exacerbating factors for plantar heel pain. The use of best available evidence to address patient-specific intrinsic and extrinsic factors led to a favorable outcome for this patient at discharge and at 7-month follow-up.

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Figure 8. Ankle dorsiflexion night splint used by the patient.

Figure 9. End range, anterior-to-posterior talocrural joint mobilization with ankle dorsiflexion over-pressure.

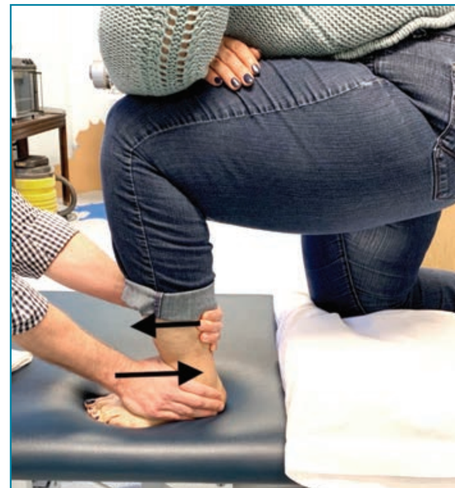

Figure 10. End range, anterior-to-posterior talocrural joint mobilization with stabilizing force over the anterior talus combined and a posterior-to-anterior directed force of the distal leg with patient in half-kneeling to improve ankle dorsiflexion.

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