Abstract

Plantar Heel pain is one of the most commonly encountered problems of foot pain in active adults over the age of 40. One in ten people will experience heel pain, and for many the problem will have a significant impact upon their daily activities. This article focuses on the differential diagnosis, investigations and management of plantar heel pain in primary care. An evidenced based approach is presented for the treatment of plantar fasciitis, especially considering the multitude of treatment modalities available.

Keywords
Heel pain, Planter fasciitis, Heel spur, Tarsal tunnel syndrome

Introduction

The foot is a beautifully engineered structure, being highly adaptive to the functions it delivers. It behaves as a flexible linkage during early stance phase (heel strike) permitting force dissipation, whilst being rigid in late stance (toe off) allowing it be a rigid lever to allow propulsion. The compartmentalised plantar heel fat pad further enhances shock absorption, whilst the static plantar fascia provides an energy efficient mechanism for standing and walking.

The bony anatomy of the foot is formed from articulations of the calcaneus (heel bone) proximally to tarsals, metatarsals and phalanges distally, constituting the medial longitudinal and transverse arches. The plantar fascia originates from the medial tubercle of the calcaneus and fans out across the superficial plantar surface of the foot to insert beyond the MTP joints onto the proximal phalanges. Passive MTP extension thus tightens this static structure and elevates the medial arch, promoting energy efficient propulsion called the Windlass mechanism. Sandwiched between the fascia and bones are the long flexor tendons, terminal branches of the posterior tibial nerve and posterior tibial vessels, which all transit behind the medial malleolus. The small intrinsic muscles of the foot are the final contents of the plantar foot compartment.

Causes of Plantar Heel pain

The most common cause of plantar heel pain in the adult population is proximal plantar fasciitis. However there are multiple differential diagnoses (Table 1), most of which can be excluded following a comprehensive history and physical examination. A history of trauma, neurological symptoms, night pain, and systemic constitutional symptoms should alert the physician to atypical aetiologies. The patient should also be directly questioned about

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<td>Proximal plantar fasciitis</td>
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<td>Compression of the first branch of lateral plantar nerve</td>
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<td>Fat pad atrophy</td>
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<td>Plantar fascia rupture</td>
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<td>Stress fracture of calcaneus</td>
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<td>Bone tumour or bone cyst</td>
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Table 1: Differential Diagnosis of plantar foot pain
their medication history as prolonged Statins and quinolone antibiotics have been associated with tendonopathy⁵. In targeted risk groups, vitamin D deficiency should also be excluded.

**Plantar Fasciitis – Characteristic features**
- Occupation history involving prolonged standing/ambulation.
- Pain is often unilateral, but can manifest bilaterally
- Insidious onset of pain without antecedent trauma. Patients may relate the onset with increased exercise activity, or weight gain.
- Pain is localised to the plantar and medial aspects of the heel. It is worse typically with the first few steps in the morning, or after a period of rest.
- The pain improves with walking and stretching, but is aggravated by prolonged ambulation and standing.

**Plantar Fasciitis – Pathophysiology**
Excessive or unaccustomed overuse causes repetitive microtears to the plantar fascia, leading to collagen degeneration. This is followed by an inflammatory response and reparative process which can double the thickness of the plantar fascia (normally approximately 3 mm). Biopsy specimens reveal collagen necrosis, fibroblastic proliferation, angiogenesis, and calcification; all in keeping with chronic inflammation.

Biomechanically, a contracture in the gastrocnemius-soleus complex, a pes cavus (high arch), or a pes planus (flat foot) deformity can all increase the traction force at the origin of the plantar fascia during weight-bearing activities.

**Work Up**

**Clinical Diagnosis**
- Plantar fasciitis is a clinical diagnosis, confirmed by typical plantar medial heel tenderness. The weight bearing plantar fascia Windlass or Jack’s test (Figure 1) is only positive in 30% of cases². The presence of significant Achilles tightness should be sought by assessing ankle dorsiflexion, as well as isolated gastrocnemius contracture by Silfverskiold’s test (differential reduced ankle dorsiflexion with knee extension v flexion) (Figure 2).

**Laboratory Studies**
- Laboratory studies are rarely indicated. However heel pain (especially bilateral), can be a rare primary presenting sign of systemic inflammatory disorders. In the presence of systemic symptoms, a full blood screen is recommended including inflammatory markers, such as the erythrocyte sedimentation rate (ESR), rheumatoid factor (RF), antinuclear antibodies (ANA), and human leukocyte antigen (HLA)-B27. Checking Vitamin D status in high risk groups is also advisable.

**Imaging Studies**
- **Plain lateral radiographs** can show calcaneal spurs in approximately 50% of patients with plantar fasciitis, but it is also noted in 19% of asymptomatic individuals⁴. As the presence of a calcaneal spur does not alter the treatment, a diagnostic x-ray is not recommended. In atypical presentations, plain lateral view radiographs of the calcaneus can be useful in detecting a stress fracture, bony infections or tumours.
- **Ultrasonographic examination** of the plantar heel can confirm a thickened plantar fascia, with associated hyperaemia. The role of ultrasound can be extended to undertake targeted injections, and hence can be requested following a failure of conservative management.
- **MRI scanning** is reserved for identifying atypical causes of plantar heel pain. It can reliably confirm a stress fracture prior to it being detectable with plain radiographs. MRI is also very useful to investigate for soft-tissue or bone tumours in the foot, as well as any space-occupying lesions in the tarsal tunnel, causing tarsal tunnel syndrome.

**Treatment**
90% of all patients with a diagnosis of plantar fasciitis can be effectively treated non-invasively, and therefore it is a prime example of a condition that can be effectively managed in the primary care setting. Although most patients automatically modify their footwear to soft flat shoes, a small minority continue to wear excessively high heels. This shoewear should be actively discouraged as it promotes Achilles tightness, thereby being counterproductive to the essential stretching exercise programme.

**Non-Invasive Therapy:**
The following modalities have been have been stratified according to their effectiveness/ evidence base from high to low.

**Stretching/ Physical therapy programme**
Physical therapy remains the gold standard treatment for plantar fasciitis symptoms. It involves stretching of the calf and foot with the knee in both the extended and flexed positions. A calf stretch is performed with the patient standing with staggered legs facing towards a wall, with both hands stretched out. The patient then leans towards the wall maintaining a stretch for 20-40 seconds, before alternating limbs. These stretches should be conducted first thing in the morning and during the day, especially after prolonged recumbency (Figure 3).

More recently a specific plantar fascia stretch programme has been advocated. This involves the patient crossing the affected foot over the contralateral leg, grasping the toes and pulling them towards the shin until a stretch in the arch is felt. The stretch is held for 10
seconds and repeated 10 times. Three sets of 10 repetitions are performed daily (Figure 4).

In a prospective RCT that compared calf stretching versus the plantar fascia specific stretch, both approaches were found to be effective in decreasing pain, with the specific plantar fascia stretch being more efficacious. Whether the combination of the two techniques produces additive benefit is still unknown.

Foot Rolling is a recommended form of local physical therapy aimed directly at the plantar fascia (Figure 5). It involves using either a hard ball, or cylindrical object (tin can, bottle, rolling pin) to massage the plantar aspect of the foot. Although there is limited evidence for its individual effectiveness, foot rolling is usually combined with other manual therapies.

**Orthotics**

Shoe inserts have been shown to be effective in managing the symptoms of plantar fasciitis. Numerous types of orthoses are available from prefabricated to custom made, soft to firm material, and full length to heel only. A RCT has shown no long term difference between prefabricated or custom made orthoses, and no added benefit from magnet-embedded insoles. Silicone prefabricated heel inserts, which are widely available, offers an excellent balance of effectiveness with low cost. Importantly, it has however been shown that stretching combined with insole use is significantly more effective than orthotics alone.

**Anti-inflammatory medication**

The use of NSAIDs may not be beneficial to the physiologic processes of soft-tissue healing, however they have been found to be efficacious in controlling pain. Anti-inflammatories are a useful adjunct in allowing more rapid progress with a physical therapy programme. The disadvantages of these medications are many, including the risk of gastrointestinal bleeding, gastric ulceration, renal damage, and cardiovascular events. Cautious prescribing is therefore advised, although topical NSAIDs combine benefits of physical application along with mild analgesic effects, and a reduced side effect profile.

**Night splints**

Most people naturally sleep with their feet in a plantar-flexed position, which causes the plantar fascia to contract at night, thereby opposing the benefits of daytime stretching. Night splints are designed to maintain the ankle in a neutral position during sleep, passively stretching the calf and the plantar fascia for a prolonged period. Although evidence suggests that 80% of patients benefit from nocturnal splinatge, their discomfort and poor compliance limits their use, and is reserved resistant cases with symptoms of plantar fasciitis for greater than 6 months. They are worn for up to 3 months, whilst continuing with a standard stretching programme.
Plantar Heel Pain

Strapping/ Taping

Arch taping is a technique provided by physiotherapists which allows the plantar fascia to stretch continuously. As taping is difficult for patients to apply correctly, there is little perceived benefit over the use of standard orthoses. No studies have evaluated the effectiveness of taping or strapping alone for managing plantar fasciitis.

Invasive Therapy

A minority of patients with plantar fasciitis (<10%), may continue to be symptomatic despite adequate conservative treatment. For such resistant cases the history and examination should be revisited to explore for any signs suggestive of an atypical cause for plantar heel pain (Table 1). There is good evidence for the efficacy of invasive procedures, but this is offset by the additional risks.

Corticosteroid injections therapy

Results of a Cochrane review6 show that corticosteroid injections are very effective in providing short term symptoms relief of plantar fasciitis, however this is not maintained beyond six months when compared with control groups. A corticosteroid injection may be given through a plantar or a medial approach, with or without ultrasound guidance. Studies have reported a reduced rate of recurrence with the use of ultrasound targeting, however concerns remain regarding the potential risks which include plantar fascia rupture in up to 10%, and fat pad atrophy. In the presence of plantar fascia rupture, clinical results are universally poor even beyond 2 years.

Surgical Plantar fascia release

Surgical intervention involves partial resection of the medial plantar fascia from its bony attachment at the calcaneus. Traditionally this is achieved with a standard medial incision, however percutaneous methods involving ultrasound guidance as well as endoscopy have been developed. Large cohort 10 year follow up case series indicate 70% of patients show improvement following surgery, but only 50% of patients display complete satisfaction2. There remains significant impairment of function in 27%, and therefore full counselling regarding the risks and benefits must be provided before embarking on surgery. Following complete division of the plantar fascia, the development of pes planus and secondary hallux valgus/ hammer toes is expected, and therefore orthotics are required lifelong post-operatively. Although partial release limits these risks, the likelihood of continuing pain remains high.

Future Treatments

Autologous blood/ Platelet injections

There is a substantially growing enthusiasm for the use of growth factor containing harvested blood/ platelet concentrate which unlike steroids can stimulate the reparative process. Blood is harvested and either injected whole, or centrifuged to remove the platelet rich plasma (PRP), before injecting it into the site of abnormality under ultrasound guidance. Its action is to stimulate an acute inflammatory reaction that leads to initiation of the healing process, and has shown early promising results in a number of chronic inflammatory musculotendinous conditions8.

Extracorporeal Shock Wave Therapy (ESWT)

This involves the use of low energy sound waves (c.f. lithotripsy) to be administered non-invasively, directly over the plantar heal. The energy imparted causes localised microtrauma that generates an inflammatory response, with angiogenesis and potential repair. This out-patient procedure takes about 30 minutes and can be performed under general or local anaesthesia. Side effects include bruising, pain, numbness, tingling and swelling. Patients who are anti-coagulated or have a bleeding tendency, are contraindicated to receive ESWT. There has been a number of RCT’s examining the efficacy of ESWT for plantar fasciitis, with mixed results being published. NICE have appreciated that although there is no concrete evidence to support ESWT, in view of its non-invasive modality and the potential to offer significant pain relief in select patients, its use is supported with adequate audit of its use9.

Conclusion

Plantar fasciitis is common problem confronting the primary care physician. Its diagnosis is primarily clinical, but care has to be taken to avoid missing unusual causes of plantar heel pain. The vast majority of patients are successfully managed with a combination of stretching exercises, heel orthoses and topical or oral NSAID use. In general, the longer the duration of symptoms, the longer it takes for the patient to obtain complete pain relief. Based on long-term follow-up data, the clinical course for most patients is positive, with 80% reporting resolution of symptoms within a 12-month period10. Refractory plantar fasciitis should alert the physician to the possibility of atypical causes, and initiate referral for imaging and consideration for invasive treatment modalities. Exciting future therapies including ESWT and PRP injections remain experimental, but offer hope to the 10% of patients who develop long term symptom chronicity.

Key points

• Nearly all patients with a diagnosis of plantar fasciitis can be managed effectively with a combination of stretching exercises, heel orthoses and NSAIDs
• X-ray imaging to confirm calcaneal spurs are unnecessary.
• Ultrasound guided injections allow the diagnosis to be confirmed, as well as accurate targeting. Blind injections are to be discouraged.
• Be alert to heel pain in elderly patients or atypical presentations, which should be referred for an orthopaedic opinion.
References


