



# Plantar fasciitis: A review

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Plantar fasciitis (PF) is a common problem presenting to the family practice office. It is seen in approximately 10% of the population and is more common in women than men. It presents with pain on the plantar surface of the foot overlying the calcaneus. The pain is most intense in the morning with the first step and after periods of inactivity. The differential diagnosis for heel pain includes other entities such as tarsal tunnel syndrome. Heel spurs are found in approximately 50% of the patients with plantar fasciitis; however, they are also found in patients without the condition and are noncontributory. Risk factors for the development of PF include lifestyle and obesity. Diagnosis of the condition is primarily clinical in nature and treatment modalities are varied. Osteopathic manipulative medicine is indicated in the treatment of the tender points associated with PF. Custom orthotics, taping, casting, and splinting are also discussed as management techniques for the condition. Surgical intervention is best left to recalcitrant patients. Future developments and ongoing studies in the management of PF include platelet-rich plasma injections and prolotherapy.  
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Upright posture and ambulation present many opportunities for pain and dysfunction in the foot. Patients often present to the family practice office with intense pain in the heel, which is usually worse upon taking the first step in the morning, or after periods of inactivity. Many possible provocations have been implicated in the development of plantar pain including long hours of standing on hard surfaces, tightness of the Achilles tendon complex, and high a body mass index. Inflammation of the plantar fascia has been estimated to occur in approximately 10% of the population over a lifetime, or as many as 2 million Americans every year.<sup>1</sup> Plantar fasciitis (PF) is reportedly more common in women than men, with a 2:1 ratio.

## Pathophysiology

The plantar fascia is a wide, fibrous band of connective tissue constructed of multiple longitudinally oriented bands

originating on the medial process of the calcaneal tuberosity and inserting at the base of the toes. The fascia is multilayered and has a thickness of approximately 3 mm. Three distinct components of this band are described: the central component, which is the largest and most prominent; the lateral component; and the medial component.

The plantar fascia contributes to support of the longitudinal arch of the foot by acting as a stabilizer. It is estimated to carry up to 14% of the total stress load. As the load is increased, tension increases within the fascia.<sup>2,3</sup> The plantar fascia demonstrates a spring action, which may contribute to energy conservation during ambulation. There is elongation of the fascia during the contact portion of gait. Dorsiflexion of the toes tenses the plantar fascia, which in turn elevates the longitudinal arch of the foot in a windlass-type mechanism providing the power for push-off. Failure of the mechanism usually occurs at the calcaneal attachment, which corresponds to the area of maximal tenderness in most patients presenting with plantar surface pain. Limited ankle flexion also contributes to the development of PF by keeping the fascia in a tightened position.<sup>1,4</sup> There are various other anatomical findings that can contribute to PF includ-

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**Table 1** Differential diagnosis of heel pain

Plantar fasciitis
Tarsal tunnel syndrome
Osteomyelitis
Occult fracture of the calcaneus
Achilles tendinitis
Calcaneal apophysitis

ing over-pronation during ambulation, leg length discrepancies, tibial torsion, or femoral anteversion. Even though these anatomical changes may contribute to the development of PF, it is more often as a result of overuse.

## Presentation of PF

The pain of PF is most intense with the first step of the morning or after periods of inactivity. Activities such as walking on the toes, climbing stairs, and walking barefoot tend to increase the pain. The pain subsides with continued ambulation but tends to return promptly once the activity has ended and the fascia returns to its resting tension. As with all functional complaints, a comprehensive structural examination must be completed to identify any correctable somatic dysfunctions that may contribute to the chief complaint.

## Differential diagnosis of heel pain

The differential diagnoses of heel pain are varied and include tarsal tunnel syndrome, neurological, osteomyelitis, occult fracture of the calcaneus, and Achilles tendon arthropathy. Neurologic causes of heel pain can occur as a result of entrapment of the tibial nerve in the tarsal tunnel affecting the calcaneal branch and causing burning pain over the dermis of the medial and plantar heel. The patient's presenting complaints usually include a burning, searing type of pain felt on the underside, or plantar surface, of the heel (Table 1).

## Diagnosis

Diagnosis of PF is made primarily by clinical presentation and does not routinely require imaging.<sup>1,3</sup> A calcaneal, or heel, spur is a frequent finding in as many as 50% of patients; it is found when radiographs are taken of the foot and can be found in patients without the diagnosis of PF.<sup>5</sup> The spur is a small bony calcification whose role in PF is under debate. The spur underlies the fascial inflammation and is not the cause of the pain. One theory of the spur formation is that repeated microtrauma to the attachment of the fascia results in the increased deposit of calcium to strengthen the area. Another theory in development of spurs

is that the constant pull of a tight fascia caused by a flattened arch causes the bone to grow or remodel in the direction of the pull. The spur itself regardless of size does not appear to be related to the development of inflammation of the plantar fascia. Injury to the origin of the plantar fascia, whether acute or chronic, caused by the overload stress and micro-trauma lead to the development of the plantar inflammation and pain.<sup>3</sup>

## Treatment

Conservative treatments vary widely and remain the mainstay in the management of PF, although no method of management is preferred over another. An article presented by Cole et al. reports that none of the conservative treatment modalities have more than inconsistent or limited-quality patient-oriented evidence grading for strength of evidence.<sup>1</sup> Nonsteroidal antiinflammatory drugs (NSAIDs) have shown effectiveness in the management of other musculoskeletal complaints, and for that reason they are included in the management of the pain associated with PF. There are no studies that have examined the effectiveness of NSAIDs and icing alone; however, these modalities are routinely used in the treatment of PF.

Stretching exercises specifically for the plantar fascia, as well as the Achilles tendon and hamstring muscles, have



**Figure 1** Plantar fascia stretching.



**Figure 2** The Heinking technique for counterstrain in treating plantar fasciitis.

shown some benefit in the reduction of pain and should be included in the first step of conservative management. Stretching of the calf muscles and plantar fascia before getting out of bed can reduce the pain of the initial morning step. Runner's stretch of the calves and stretching of the hamstrings has been shown to provide limited reduction in the symptomatology caused by PF.<sup>6</sup> Plantar fascia-specific stretching appears to have the greatest effect on reducing morning pain.

There are many types of stretches for the plantar fascia. One is accomplished by crossing the affected foot over the contralateral leg, grasping the base of the toes, and pulling the toes back toward the shin until a stretch is felt in the arch (Fig. 1). The stretch is held for 10 seconds and then repeated for three sets of 10 daily.<sup>6</sup>

Initial osteopathic evaluation of the patient with plantar fasciitis should begin with evaluation of the axial components of the lumbosacral spine, pelvis, hips, knees, and feet.<sup>5</sup> Tension in the muscle groups of the iliopsoas, hamstring, gastrocnemius, and soleus should be identified and can be treated with release techniques such as counterstrain.<sup>7</sup> Tender points can often be identified within the plantar fascia itself and again can be treated using counterstrain techniques (Fig. 2). The Heinking is one such technique accomplished with the patient lying supine and the

physician seated on the foot of the table. The patient's ipsilateral knee is flexed and the plantar tender point identified where the fascia inserts onto the calcaneus. One thumb is used to monitor the tender point, whereas the opposite hand plantar flexes the toes and ankle curving around the tender point. Additional adjustment to the tension may be accomplished by supination or pronation of the foot until there is symptomatic relief of the tenderness underlying the monitoring thumb. This position of ease is held for approximately 90 seconds or until there is softening of the tissues below the monitoring thumb. The foot is then returned to the neutral position without moving the monitoring thumb. Re-assessment of the tenderness should be completed at the end of the treatment.<sup>5,8</sup>

When custom orthotics, off-the-shelf orthotics, and sham orthotics were compared, custom orthotics were found to statistically significant short-term improvement in functionality compared with sham orthotics. Off-the-shelf orthotics proved to be as effective as custom orthotics in the management of acute PF.<sup>9</sup> Custom orthotics did provide statistically significant short-term improvements in functionality when compared with sham orthotics; however, there was no long-term effect when re-evaluated at 12 months.<sup>9</sup>

Taping of the plantar surface of the foot was also shown to provide reasonable short-term benefit; however, the evidence supporting taping is weaker than that for orthotics.<sup>10</sup> Many variations on plantar fascia taping are available; however, the overall goal is to reduce the tension on the plantar fascia when it is weight-loaded. Most techniques begin with an anchor of tape placed circumferentially around the ball of the foot area and then continuing in a "figure-eight" around the heel. This is usually repeated three times to provide the needed strength. Tape is then applied horizontally to cover the entire plantar surface and reinforce the "figure-eight." The tape can be left in place for several days, removed to check the integrity of the skin, and then reapplied.

Multiple styles of prefabricated nighttime splints are available that hold the foot in dorsiflexion during sleep. Overnight dorsiflexion prevents shortening of the fascia, thus decreasing the pain of stretching when weight-loaded with the first morning steps. Custom dorsiflexion splints made in the office can also provide relief when used consistently at night and have shown to be more efficacious

**Table 2** Treatment of plantar fasciitis

Conservative	Surgical	Current trials
Nonsteroidal antiinflammatory medications	Extracorporeal shock wave therapy	Prolotherapy <sup>16</sup>
Icing	Disruption of the plantar fascia	Platelet rich plasma injections <sup>18</sup>
Stretching		
Osteopathic manipulative medicine/Counterstrain		
Steroid injections		
Iontophoresis		
Taping		
Casting/splinting/custom orthotics		



than prefabricated ones, although evidence to support the use of either is lacking.<sup>1,11</sup> Rigid casting or walking boots can also be used to rest the plantar fascia, especially in patients who have not responded to more conservative care.

Steroid injections into the plantar fascia can be considered for patients who fail initial management interventions. They may provide temporary, or in some cases permanent, relief; however, the injections can be quite uncomfortable and the risk of ligament rupture exists. Although they provide short-term benefit, there has been no reported long-term improvement. Ultrasound guidance improves the accuracy of the injection placement and may improve resolution rates, but it does not change the risk of tendon rupture.<sup>12</sup> Iontophoresis with dexamethasone, in combination with stretching and taping, has been shown to have short-term effects on decreasing pain and increasing function.<sup>13</sup> Studies looking at the use of extracorporeal shock wave therapy have given differing results, with one study showing benefit in distance runners while the other showed little or no benefit.<sup>14,15</sup>

Consultation with specialists for further management should be considered in patients who have not responded to the conservative approach. Guidelines from the American College of Foot and Ankle Surgeons recommend considering referral for surgical evaluation if pain persists after three months of conservative treatment.<sup>2</sup> Surgical disruption of the plantar fascia, although it may provide immediate benefit, has some long-term consequences, such as fall of the arch. The risks of surgery include nerve damage, infection, and failure to relieve the pain. Ultrasound-guided fasciotomy can be done as a minimally invasive technique using a needle to disrupt the tissues.<sup>13,15</sup> Multiple small disruptions are created in the fascia, which stimulate the body to repair the acute damage by increasing blood flow to the area and in turn stimulating healing of the chronic inflammation.

A current Phase IV clinical trial is underway to examine the role of prolotherapy in the management of PF.<sup>16</sup> Prolotherapy is accomplished by injecting an irritant solution such as high-concentration dextrose into the attachment area of the ligament, thereby initiating scarring and decreasing pull on the attachment. Although prolotherapy has been performed for PF in the past, there has been limited controlled study of its effects. Platelet rich plasma (PRP) injections into the plantar fascia to promote increased blood flow and use the natural healing in the damaged ligament is being evaluated in another trial.<sup>17,18</sup> Recommendations for more invasive therapy, such as surgical intervention, prolotherapy, or PRP injections, should be reserved for discussion between the patient and the specialist (Table 2).

## Summary

Plantar fasciitis is a painful and debilitating condition for the majority of people in whom it develops. An understand-

ing of the anatomy and mechanism of weight-loading of the plantar fascia can aid in understanding the pathophysiology of this condition. Osteopathic manipulative therapies, as well as multiple conservative measures, are available and have demonstrated some benefit in the management of PF. More intensive treatments such as injections and surgery carry concomitant risks; however, they may provide an option for patients who fail conservative management.

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