

Plantar Fasciitis: A Review of Current Diagnostic and Treatment Methods

2.0 Contact Hours

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Plantar Fasciitis: A Review of Current Diagnostic and Treatment Methods

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Objectives:

1. Recognize the signs and symptoms of Plantar Fasciitis
2. Understand the pathology behind the disorder
3. Identify risk factors for PF
4. Know 3 differential diagnoses
5. Identify signs of other sources of similar pain patterns
6. Understand the various diagnostic modalities
7. Know the treatment for acute symptoms
8. Identify conservative and invasive treatments
9. Be aware of methods to prevent recurrence
10. Understand prognosis

1. Background

“Time wounds all heels.”

~Recently found in a Chinese Fortune Cookie

At one time or another, almost everyone will experience heel pain. For some, the discomfort may be an intermittent annoyance, but heel pain can be severe enough to cause extreme disability. A significant number of patients who experience heel pain are unable to participate in sports and exercise, perform jobs that require standing or walking and even manage some of the basic activities of daily living. Even moderate pain can make it difficult to continue an exercise regimen or just continue the activities that people enjoy.

One of the most common causes of heel pain is Plantar Fasciitis (PF). It's estimated that up to 10% of the population at some time suffers from this condition. Each year, an estimated 2 million people seek treatment for PF.⁵ Of approximately 1 million annual visits for heel pain, about two-thirds were seen by an orthopedic specialist, and one third by their primary care doctor². Most podiatrists would agree that about 25% of the new patients they see complain of heel pain.

In this article, a review of the causes of heel pain and specifically PF will be reviewed. A systematic diagnostic strategy will be examined and treatment options will be presented. Finally, recommendations for prevention will be offered. Following this article, the reader should have a comprehensive understanding of PF and how to accurately diagnose and treat patients who present with heel pain.

Because the onset can be insidious, many people don't realize the extent of the pain and disability until it becomes too painful to get out of bed in the morning. The average patient attempts self-treatment for 3-6 months before seeking medical care. The most common ways patients try to alleviate the pain are through changing shoes, adding over-the-counter heel cushions or shoe inserts, taking non-prescription pain medications and using heat or ice.

In 80% of patients, the pain is self-limiting, resolving without treatment over the course of 6 to 18 months^{2,3,4}. While the great majority of cases of PF are mechanical in nature and resolve within 6 to 12 weeks of treatments, some cases are more complex. For the remaining minority of patients, finding relief is difficult; between 5-10% of patients develop chronic, persistent pain⁵.

A review of current literature confirms that early and aggressive treatment of heel pain can speed recovery and reduce the chances that PF will become resistant to therapy or progress to a chronic condition. For a small group of patients, more aggressive treatments are needed. A handful of more serious causes can be at the root of a painful heel and must be ruled out. Even though heel pain is often innocuous, systemic causes must be ruled out. In a very small subset of patients, heel pain is a warning sign of a systemic illness. To provide the best treatment, a complete evaluation and physical exam should be performed to differentiate between a simple musculoskeletal problem and a medical problem requiring more involved diagnosis and treatment.

2. Pathophysiology

PF is an inflammation of the wide band of ligamentous tissue called the plantar fascia that spans the bottom of the foot. The band originates from the inferior (plantar) aspect of the calcaneus and attaches by a series of fibers into the area beneath the metatarsophalangeal joints in the forefoot. The plantar fascia consists of three portions; a thick central band, a medial and a lateral band. The central band lies superficial to the four layers of muscles in the foot and helps to support the medial arch. The medial and lateral bands support the abductor digiti quinti and abductor hallucis muscles. The medial and lateral plantar nerve branches travel between the bands of the fascia. When the foot pronates and unlocks, the plantar fascia is stretched as the medial arch lowers.

Increased tension on the plantar fascia pulls the fibers from their bony attachments, causing an inflammatory response. Increased blood flow brings more white blood cells to the area causing swelling and discomfort. A single traumatic injury to the plantar fascia can tear the plantar fascia away from its attachment to the calcaneus, triggering an inflammatory response. More commonly, excessive pronation that leads to repetitive micro trauma causes PF.

Histologically, microtears of the plantar fascia are seen along with collagen degradation, fibrocyte necrosis and chondroid metaplasia. Angiofibroblastic proliferation indicated vascular regeneration. These microscopic findings are suggestive of the proposed

mechanism of damage: chronic degenerative changes from overuse and constant mechanical overload on the plantar fascia

The plantar fascia serves a critical functional role. As the foot contacts the ground during the gait cycle, it remains flexible to accommodate any irregularities in the surface and absorb shock. As the gait cycle continues, the PF assists the foot in efficiently converting to a more stable rigid level through the “windlass” mechanism. This stability allows the foot to propel the body forward and complete the gait cycle.

Various biomechanical abnormalities, both structural and functional, can cause excessive pronation, including pes planus, leg-length discrepancy, excessive lateral tibial torsion, and excessive femoral anteversion. Pes cavus, or a high arched, immobile foot will undergoes increased tension on the plantar fascia because it cannot accommodate to absorb ground reactive forces.

3. Signs and Symptoms of PF

Patient complaints in PF are generally very classical. Almost invariably, patients report a slow onset with no obvious precipitating trauma. Frequently, patients aren't able to pinpoint exactly when they began to notice symptoms. The pain is usually localized to the plantar heel and more specifically the medial aspect of the heel, although patients may relate pain in other areas. The nature of the pain is most often described as throbbing or burning soreness, with occasional reports of tingling or radiation proximally.

A description of pain that is worse in the mornings or after long periods of rest, or exquisitely tender with the first step of bed is pathoneumonic for PF. Many patients report that they “can't even step out of bed in the morning.” It is not unusual for a patient with PF to report a minor injury that is out of proportion to the length and degree of pain. Frequently, patients report some relief with new gym shoes, rest or OTC pain relievers. When the pain does not completely resolve after several attempts at self-care, patients eventually seek professional treatment.

Bilateral heel pain occurs about 15% of the time, but unilateral pain is much more common. Bilateral complaints should be a red flag to the practitioner to closely evaluate the patient for systemic sources of disease.

Other common complaints that may seem confusing to the clinician result from compensatory changes in weight bearing and gait. These include forefoot pain, leg cramps, tendonitis and peroneal spasm. Knee, hip or lower back complaints are also possible.

4. Diagnosis

History & Physical

PF is frequently a clinical diagnosis. A careful review of the patient's history and a focused physical exam are often sufficient to make the diagnosis. The classic history of an increasingly painful heel that is worse in the morning and improved with activity should raise the clinician's suspicion of PF.

A complete physical exam is necessary to help rule out other causes and determine the exact nature of the underlying problem. To confirm the diagnosis, the clinician should be able to duplicate the pain by firm palpation one to two thumb-widths from the medial calcaneal tuberosity. Most commonly, the point of maximal tenderness is located over the calcaneal tuberosity, but may also be in the center of the plantar heel pad. Minor swelling may be present.

Redness, however, is uncommon. Combined with localized edema and a palpable deficit in the plantar fascia, rupture should be considered. It may also suggest an infective process which should be carefully worked up.

When examining the lower extremity, the circulatory and integumentary systems should be assessed for any abnormalities. Neurological findings should also be essentially normal. The examiner should attempt to elicit Tinel's or Valleix's sign at the posterior tibial nerve to eliminate the possibility of tarsal tunnel syndrome or other nerve entrapment. A straight leg raise test can help rule out radiculopathy.

Careful attention to the biomechanics of the leg, foot and ankle can help pinpoint the dysfunctional aspects at the root cause of PF. Muscle strength, reflexes and range of motion of the ankle, subtalar, midtarsal and metatarsophalangeal joints should be evaluated as part of the biomechanical exam. The degree of ankle joint dorsiflexion should also be evaluated.

Imaging

The need for plain film radiographs in the diagnosis of PF has been a topic of debate. Because PF is a soft tissue condition, it cannot be specifically visualized on x-rays. The primary utility of radiographs is in detecting confirmatory signs or ruling out other causes of heel pain.

Rarely, radiographs reveal an unexpected cause of heel pain: these include solitary bone cysts, stress fractures, coalitions, infection, arthritis or lesions. Radiographs can also prove helpful in following the course and response to treatment of PF. Baseline films are particularly useful in cases where resolution is elusive.

Radiographic signs suggestive of Plantar Fasciitis

- Heel spur/osteophyte
- Fluffy bony activity
- Plantargrade bony positioning of the calcaneus
- Pes planus or flatfoot
- Ankle joint bony impingement (bony equinus)
- Calcifications within the plantar fascia

In cases where infection is suspected or it is difficult to differentiate between possible diagnoses, MRI or CT may prove helpful. The gold standard to detect infection as opposed to inflammation is gallium enhanced T⁹⁹ bone scan.

Lab Studies

Laboratory studies should be done when considering any systemic illness or arthritis processes. Red flags that heel pain is related to a systemic disorder also include pain in other joints, pain not relieved by rest and known inflammatory arthritis conditions. These typically include:

- CBC w/Diff
- WBC
- ESR
- Uric Acid
- HLA-B27

Although the diagnosis of PF can often be made through history and physical exam reliably, a small number of cases may still be equivocal. If treatment has not provided any relief, further studies are warranted.

5. Differential Diagnoses

Vascular/ Integument

Diabetes/diabetic neuropathy
Neuropathy

Neurological

Calcaneal neuritis
Lumbosacral radiculopathy of S1 nerve root
Entrapment of medial calcaneal branch of posterior tibial nerve
Entrapment of first branch of lateral plantar nerve
Tarsal tunnel syndrome

Musculoskeletal

Acute traumatic rupture of the plantar fascia
Calcaneal stress fracture
Retrocalcaneal bursitis

Sever's disease (calcaneal apophysitis in children aged 7-15 y)
Atrophy of plantar fat pad

Systemic

Psoriatic arthritis

Ankylosing spondylitis

Reiter's syndrome

Rheumatoid Arthritis

Gout

Infection - osteomyelitis

Tumor

Foreign body

6. Treatment

There are many simple ways to speed recovery so that patients can return to their usual activities more quickly. After other pathologies have been ruled out, initial treatment should be aimed at reducing the inflammation, and thus the pain experienced by the patient. Once the acute phase has been managed, and the pain has been reduced, careful evaluation of the underlying causes is needed to address any structural or biomechanical problems. Failure to treat these problems is associated with a higher incidence of recurrence.

Acute treatment

Reduction of inflammation and pain can be accomplished in several ways which should be individualized to the degree of tenderness present. Treatment can be divided into three categories: oral anti-inflammatory medications, injectable steroids and external physical treatments.

Studies show that many single interventions are useful in reducing symptoms and eliminating pain. In one study 30% patients treated with cushioning devices noted improvement, while 33% treated with anti-inflammatories improved and 70% patients receiving biomechanical support improved (Stadler). Rest alone was reported to be the most helpful y patients in another study, with 29% reporting that stretching was most helpful. Use of night splints was also reports as proving relief in 88% patients in another study. ¹

Combination therapy, however, is the most effective strategy for long term pain relief when managing PF ^{1,3,6,7}. The most effective treatment strategy for providing quick relief and long-term results is a combination of reducing the inflammation calcaneal attachment insertion of the PF, as well as controlling the microtrauma that stresses the plantar fascial complex.

Treatment strategy by degree of discomfort

Pain Level	Initial Intervention	Secondary Intervention
Mild to moderate pain	<ul style="list-style-type: none"> • Strapping • Oral NSAIDS 	Stretching Physical therapy Appropriate Shoe gear
Severe pain or disability	<ul style="list-style-type: none"> • Strapping • Corticosteroid injection 	Stretching Physical Therapy Modify Shoe gear Avoid walking with bare feet
Poor response to treatment	<ul style="list-style-type: none"> • Medrol Dose Pak • Corticosteroid injection 	Custom molded orthoses Non-WB short leg cast Night Splints
Persistent pain of 6 months duration	Review diagnosis	Consider ESWT* or surgical intervention

* ESWT= Extracorporeal Shock wave therapy.

NSAIDs can be used for a short course of treatment from 2-3 weeks up to 3 months. By interfering with the prostaglandin cycle at various points, these agents eliminate the painful inflammation and speed healing.

Once the initial pain has subsided, a home stretching program can begin and the patients can return to mild activity. As soon as the patient can tolerate stretching, it should be incorporated into the treatment plan. Athletes should be discouraged from full return to their routines until near complete resolution of symptom has been achieved. Activities such a riding, rowing or swimming can help maintain cardiovascular fitness while allowing the plantar fascia to heal.

Direct injections of steroids have successfully been used for many soft tissue and joint complaints since the 1950s. Injections of various steroids to the inferior calcaneus area of inflammation can provide fast relief of symptoms in severe cases of PF. Ultimately, however there has been no demonstrated advantage in the long-term resolution of symptoms when compared with other treatment methods. Because direct infiltration of steroids into the plantar fascia can cause rupture, careful attention to technique and avoidance of overuse are critical (Sellman).

A commonly used protocol for steroid injections for PF consists of a series of three injections given one to two weeks apart. For immediate pain relief, a local anesthetic such as lidocaine 1% plain, mixed with marcaine 0.5% plain is added to a long acting steroid such as Decadron or Celestone or Kenalog. Triamcinolone 10 mg and

dexamethasone 2.5 mg have also been used with success. To reduce discomfort, a 25g needle is used. Topical application of ethyl chloride may reduce the pain of injection as well. This author's experience suggests that if one or two injections provide some relief, a third and final injection gives longer lasting resolution of symptoms.

A study comparing the efficacy of corticosteroid injection to ESWT in treating PF showed the corticosteroid to provide better control of pain within the within the first 3 months. However, at one year, there was no significant difference in the pain between the two groups⁸.

For extremely recalcitrant pain (over 3 months), complete immobilization in a short leg cast has been used with success. Although seemingly drastic, this method has been effective when other, less restrictive methods have failed. An alternative that offers immobilization but allows range of motion exercises and physical therapy to prevent muscle atrophy during treatment is the use of a removable immobilization device such as a 3D Walker.

Long-term treatment

Once the acute pain has resolved home stretching exercises frequently eliminate the remaining tenderness. Particularly when performed prior to getting out of bed, patients report significant relief from stretching programs.

A variety of devices are available to help patients perform stretching at home. Certainly these devices can be useful, but simply using a bath towel works quite well. Each morning before getting out of bed, patients should be instructed to wrap a towel around the affected forefoot, and with the ankle at a 90 degree angle, gently pull the foot towards the body. Stretching should always be done with slow, smooth movements. After 10-30 seconds, patients usually feel the area relax. This should be repeated 2-3 times.

Patients should do several stretches during the course of the day, particularly after sitting for extended periods. This can easily be incorporated into regular activity. Tennis balls and golf balls are useful to roll under the foot with varying pressure. And, they can easily be stored in a desk drawer at work. Many patients get better relief by using a cold canned beverage to roll along the floor using the bottom of the foot. This not only stretches, but aluminum can is an excellent conductor of cold, and cools the inflamed area. (Be sure to remind patients not to stand on the can).

Because some fibers of the plantar fascia are thought to be continuous with the fibers of the Achilles tendon, stretching on the entire lower leg is important. A tight Achilles tendon also puts tension on the calcaneus, and further tightens the plantar fascia. Stretches for the lower leg include a variety of standing stretches. One of the most common is to hold a wall of counter for support while bending the knee with the foot firmly on the ground. This works on the soleus muscle. Straight knee stretches, which work on the gastrocnemius muscle, are also helpful.

Another way to stretch the Achilles tendon is by placing the foot at the edge of a step. With the heel off the edge, the patient gently presses their body weight to lower the heel. This works on both the plantar fascia and the Achilles tendon. This stretch should be done carefully; too much pressure can cause tearing of the plantar fascia.

Along with stretching, studies have shown that strengthening the small muscles of the bottom of the foot is helpful in supporting the arc of the foot, and reducing the forces that put pressure on the plantar fascia.

6b. When Conservative therapy fails.....

A review of current studies confirms this author's experience that 80- 90% of patients who seek treatment early and receive a combination of therapies have a rapid resolution of their symptoms. Patients who have had heel pain for more than six months, have limited ankle dorsiflexion, are overweight or have jobs that require extended standing are at a higher risk for failing conservative treatments.

After 3- 6 months of conservative treatment without improvement, it pays to re-evaluate the clinical findings to ensure that the diagnosis is accurate. Particularly when heel pain is present in both feet, a systemic disorder may be the cause. Blood work, including sedimentation rate (ESR, HLA-B27) may shed additional light on potential systemic arthritides. When all other possibilities are exhausted, more aggressive treatment for PF can be considered. Among healthcare professionals who treat this condition, most agree that conservative care should be attempted for at least 6 months, although some suggest 12 months.

Surgery, until recently, was the only option remaining for patients with recalcitrant PF. The original procedure was an open one, where the plantar fascia was severed from its attachment to the calcaneus. The recovery from this procedure was long, and required a non-weight bearing cast for 6-8 weeks. Post-operative complications and the development of pain in other areas were common outcomes. From this experience, it became clear that the best results were obtained by transecting only a portion of the medial part of the plantar fascia.

Current surgical procedures for PF include percutaneous sectioning of the plantar fascia through a small incision, and endoscopic plantar fasciotomy. These procedures have a much shorter recovery time, less complications and do not require a period of non-weight bearing. In fact, following an endoscopic procedure, moderate weight bearing in a surgical shoe is recommended to prevent reattachment of the plantar fascial fibers. Most surgeons have a specific procedure they feel most comfortable with. Results of surgical treatment vary, with some studies reporting a rate of 50% resolution of symptoms, and others reporting between 80-90% resolution.

The newest innovation in treating recalcitrant PF is orthotripsy. Extra-corporeal shock-wave therapy is used at the site of discomfort while the patient is under anesthesia. The exact mechanism of action has not been determined, but ESWT appears to accelerate the reparative process, speeding resolution of symptoms. The procedure is non-invasive,

requires no immobilization or recovery time and does not have the usual surgical complications such as infection. For these reasons, patients are more willing to undergo ESWT treatment than surgery.

Several recent studies of ESWT show very promising results, with impressive rates of resolution. Success rates found in several studies range from 48% to 78% ⁸. One follow-up study of ESWT reported that of patients who eventually needed open surgery for continuing heel pain, nearly triple the number of patients had been treated conservatively, compared to those who underwent ESWT. This finding suggests that ESWT may be more effective in long-term resolution of PF symptoms.

Prognosis

For most patients who seek treatment for PF, early and aggressive treatment will provide improvement within 3 months. If any biomechanical abnormalities are addressed, over three-quarters of these patients can expect long-term relief of symptoms. In a small group of patients (5-10%), the plantar fascia remains chronically inflamed.

Patients who do not attain adequate improvement after 6 months of conservative care can be treated with more invasive therapies. Extra-corporeal shock-wave therapy appears to be beneficial for this subgroup of patients. Results from various studies show a successful outcome in 50% to 80% of patients who undergo this treatment after undergoing a course of conservative therapy.

In the remaining patients who still do not get relief, open and endoscopic surgical procedures can provide relief. Thus, the majority of patients with painful PF have a resolution of symptoms within 6 to 12 months. Only a very small percentage of patients are unable to find at least some relief.

In addition to early treatment, weight loss, changes in shoe gear, and modification of jobs that require prolonged periods of standing are strongly correlated with reduction of symptoms.

Prevention

PF is a condition that has a high rate of recurrence. Several factors increase the chance that a patient will experience continued symptoms. If these risk factors are addressed, the chance of full resolution of symptoms is much greater. Prevention of recurrence rests largely on patients' compliance. So educating the patients is crucial to maintain long-term results.

Risk Factor	Effect	Interventions
Obesity	Increases tension on plantar fascia	<ul style="list-style-type: none"> • Maintenance of a healthy weight • Weight loss program
A job that requires long periods of standing	Increases tension on plantar fascia	<ul style="list-style-type: none"> • Increase cushioning in shoe gear • Modify work duties • Add cushioned flooring to work area
Tight Achilles tendon or insufficient dorsiflexion at ankle	Pull on calcaneus increased tension of plantar fascia	<ul style="list-style-type: none"> • Stretching • Achilles lengthening
Excessive pronation due to structural or function deformity	Increased tension of plantar fascia	<ul style="list-style-type: none"> • Biomechanical control; consider custom molded orthoses
Inappropriate or worn out shoe gear	Allow excess pronation, Inadequate cushioning of heel	<ul style="list-style-type: none"> • Educate patient of proper foot wear. • For runners: Replace shoes after 500 miles or 6 month

Summary

Although PF is not a serious or urgent threat to health, it can be incredibly painful and disabling. Patients suffering from severe symptoms may have difficulty performing their regular daily activities, leisure activities or job responsibilities. While many cases of PF are self-limiting and resolve on their own, symptoms can linger for as long as 18 months. Often, the pain recurs with increasing frequency.

The diagnosis of PF is frequently made clinically. When the diagnosis is unclear, ultrasonography and MRI have been helpful. In cases of suspected infection, T-99 bone scans can differentiate inflammation from infection with the highest degree of sensitivity. Early and aggressive treatment speeds the recovery time to as little as 6-12 weeks and significantly reduces the likelihood that the disorder will become chronic and resistant to treatment.

PF treated early requires less intervention and is less likely to result in surgical treatment. Treatment is most effective when a combination of modalities is employed. Patients should be educated on effective self-care including a home stretching program, how to choose appropriate shoe gear and the importance of biomechanical control. For patients with structural or biomechanical problems, long term relief is best achieved with some form of arch support. This author has seen the best results with custom molded orthoses,

although studies have not shown a statistical significance between pre-fabricated and custom molded appliances as yet.

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