

Diagnosis and Management of Plantar Fasciitis

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Plantar fasciitis, a chronic degenerative process that causes medial plantar heel pain, is responsible for approximately 1 million physician visits each year. Individuals with plantar fasciitis experience pain that is most intense during their first few steps of the day or after prolonged standing. The authors provide an overview of the diagnosis and management of a common problem encountered in the primary care setting. Routine imaging is not initially recommended for the evaluation of plantar fasciitis but may be required to rule out other pathologic conditions. Overall, plantar fasciitis carries a good prognosis when patients use a combination of several conservative treatment modalities. Occasionally, referral to a specialist may be necessary.

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The initial evaluation of plantar fasciitis often occurs in the primary care setting.¹ Although the diagnosis is often straightforward, an extensive list of alternative diagnoses may need to be ruled out. Effective treatment is predicated on the modification of risk factors and the implementation of an evidence-based treatment approach.² Ultimately, a good prognosis is expected.

The aim of the present article is to provide the reader with an overview of the diagnosis and management of plantar fasciitis, a problem commonly encountered in the primary care setting. To identify current best practices, we conducted a thorough search of the English language literature for articles containing information pertaining to the diagnosis and management of plantar fasciitis. Only peer-reviewed articles were included, and preference was given to studies with higher levels of evidence. Current clinical practice guidelines for plantar fasciitis were also reviewed, and recommendations are incorporated herein.

Anatomy

The plantar fascia comprises 3 bands of dense connective tissue, which originate at the medial tubercle of the calcaneus and fan distally to insert into the base of each proximal phalanx (*Figure 1*).³ First described by Hicks⁴ in 1954 as the *windlass mechanism*, the plantar fascia tenses during the terminal stance to toe-off phases of gait.^{3,4} This tension elevates and reinforces the medial longitudinal arch, which in turn allows the foot to function as a rigid lever for forward propulsion.⁵

Pathophysiology

Plantar fasciitis is a chronic degenerative process involving the plantar aponeurosis of the foot, most commonly at its insertion into the medial tubercle of the calcaneus. The process involves repetitive strain that seems to cause microtearing, which induces a repair response.^{4,6} Histologic analysis demonstrates marked thickening and fibrosis of the plantar fascia along with collagen necrosis, chondroid metaplasia, and calcification.^{6,7} Although plantar fasciitis has historically been assumed to be primarily an inflammatory process, these findings suggest a principally degenerative mechanism, leading some authors to suggest that *plantar fasciosis* may be a more histologically accurate term.^{6,8}

Epidemiology

Each year approximately 1 million office-based physician visits result in a diagnosis of plantar fasciitis.¹ Most patients initially seek care from their primary care physi-

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cian.¹ The peak incidence of plantar fasciitis occurs in persons aged between 45 and 64 years, and it is more common among women.^{1,9} Other at-risk populations

include persons with flat (planus) or high-arched (cavus) feet, long-distance runners, military personnel, persons with occupations requiring prolonged standing, and persons who are obese or sedentary.⁹⁻¹¹ Up to one-third of patients may present with bilateral plantar fasciitis.⁶

Diagnosis

Clinical Evaluation

Plantar fasciitis is primarily a clinical diagnosis. Patients classically describe medial plantar heel pain on weight bearing, which is often most intense during their first few steps in the morning but tends to improve with rest.^{3,12} This pain may progress over the course of the day, especially after prolonged standing. Acute exacerbations may occur at any time when rising from a seated position.^{3,12} Physicians should look for other risk factors for plantar fasciitis and assess the appropriateness of the patients' footwear choices for their customary activities.

A thorough musculoskeletal examination of both lower extremities should be performed. Classic physical examination findings suggestive of plantar fasciitis include reproducible pain with palpation of the plantar medial aspect of the heel and pain with passive dorsiflexion of the ankle and toes (windlass test).¹² A contributing planus or cavus foot deformity may be noted.^{3,12} Ankle range of motion should also be assessed. Active dorsiflexion less than 10° beyond neutral is indicative of an equinus contracture.¹³

The *Table* summarizes the distinguishing historical and physical examination findings of other items in the differential diagnosis of plantar fasciitis.

Imaging

Diagnostic imaging is not recommended for the initial evaluation of plantar fasciitis.²¹ However, magnetic resonance images, triple-phase bone scans, or other imaging results may be required to rule out other considerations in the differential diagnosis, particularly when 4 to 6 months of nonsurgical treatment has failed or when the patient presents with atypical heel pain (*Table*).¹²

KEY POINTS

Plantar fasciitis is primarily a clinical diagnosis that requires a thorough history and physical examination because of the breadth of the differential diagnosis.

Female patients, middle-aged patients, long-distance runners, military personnel, obese patients, and individuals with a cavus or planus foot deformity are at an increased risk for developing plantar fasciitis.

Nonsteroidal anti-inflammatory drugs, focused stretching, footwear modifications, and over-the-counter orthotics are recommended for the initial management of plantar fasciitis.

There is limited evidence supporting the efficacy of osteopathic manipulative treatment for patients with plantar fasciitis.

The risks associated with corticosteroid injection of the plantar fascia include skin and fat pad atrophy, infection, and plantar fascia rupture.

Treatment

Nonsurgical

Approximately 85% to 90% of patients with plantar fasciitis can be successfully treated without surgery.⁶ Methods include rest, over-the-counter (OTC) nonsteroidal anti-inflammatory drugs (NSAIDs), stretching, counterstrain technique, orthoses, corticosteroid injections, extracorporeal shock wave therapy (ESWT), and ultrasound therapy.

Although treatment may be required for 6 months or longer, 80% of patients treated conservatively have no long-term recurrence of pain.^{1,16} Current recommendations for the conservative management of plantar fasciitis call for a multimodal, evidence-based approach.²

Initial treatment should include sufficient foot rest with conservative analgesic use. Over-the-counter NSAIDs have been shown to be an adequate means of pain control when used in combination with other forms of treatment.^{22,23} Focused stretching of the Achilles tendon, plantar fascia, and intrinsic muscles of the foot has also been dem-

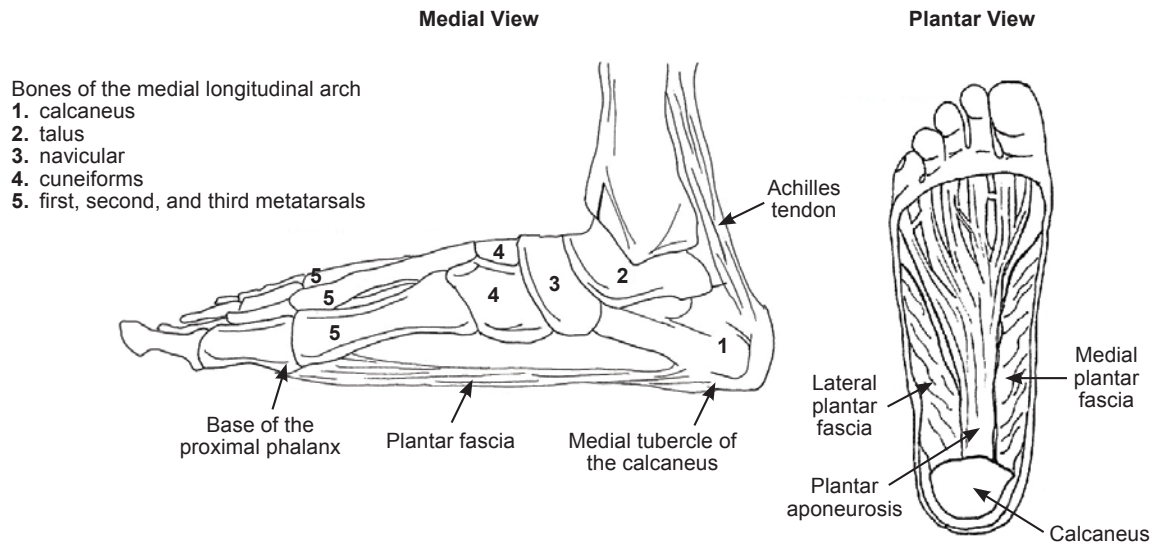


Figure 1.

The plantar fascia supports the medial longitudinal arch by transmitting forces between the heel and forefoot during the late stance to toe-off phases of gait.

onstrated to improve pain.^{24,25} The intermittent application of ice seems to provide some benefit to patients with plantar fasciitis when compared with heat application.²³

The osteopathic manipulative treatment technique of counterstrain may provide immediate improvement of plantar fasciitis symptoms; however, maintenance of these results has not been documented, to the authors' knowledge.^{26,27} The plantar fascia should be placed in a position of least resistance with passive flexion of the knee and plantar flexion of the ankle and toes.²⁷ This position should be maintained for approximately 90 seconds while monitoring the tenderpoint, which is most commonly located at the plantar fascial insertion on the medial calcaneus.²⁷ The foot should then be returned to a neutral position and reassessed.²⁷

A wide variety of orthosis options are available for the management of plantar fasciitis. The use of shoe inserts (eg, silicone heel pads, felt pads, and rubber heel cups) in combination with stretching exercises has been shown to provide superior short-term improvement in

heel pain compared with stretching alone.²⁸ A randomized, controlled study comparing OTC shoe inserts with customized shoe inserts found no significant difference in pain relief between the 2 groups at 12-month follow-up.²⁹ Regardless, the long-term efficacy of shoe inserts for plantar fasciitis is uncertain.³⁰ The use of posterior-tension night splints has also shown benefit in patients

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with chronic plantar fasciitis.^{16,31} The suspected therapeutic mechanism of night splinting is the maintenance of ankle dorsiflexion and toe extension, creating a constant mild stretch on the plantar fascia, presumably allowing it to heal at a functional length.^{16,30}

Corticosteroid injections should be considered with caution, owing to a potentially unfavorable risk-to-benefit ratio for patients with plantar fasciitis. In a ran-

Table.
Differential Diagnosis of Plantar Fasciitis^{2,3,12-18}

Diagnosis	History	Physical Examination Findings	Diagnostic Imaging ^c
Skeletal Origin			
Acute calcaneal tuberosity/body fracture	High-energy axial overloading through heel such as from a fall or MVA	Patients often unable to ambulate; acute ecchymosis and swelling of heel	Plain radiography
Calcaneal stress fracture ^a	Overuse injury associated with sudden increase in athletic activity; deep, dull pain in calcaneal tuberosity worsened by walking on hard surfaces	Reproducible pain with simultaneous medial and lateral compression of calcaneous (squeeze test ^a)	MR imaging, single-phase bone scan
Subtalar and talonavicular arthritis ^b	Insidious lateral and medial heel pain, respectively, and relieved with rest	Pain, swelling, and stiffness worsened by weight-bearing activity	Plain radiography
Soft Tissue Origin			
Acute plantar fascia rupture	Acute plantar “pop” followed by severe heel pain with foot swelling	Ecchymosis and swelling in plantar heel and midfoot; palpable mass under medial arch may exist	Noncontrast MR imaging
Fat pad atrophy	Centrally located heel pain worsened by walking on hard surfaces; most common in elderly patients	Deep pain with palpation of medial aspect of heel	MR imaging
Insertional Achilles tendonitis	Posterior heel pain worsened by ascending stairs or hills	Point tenderness over posterior tendon of foot; Achilles contracture may be present	Noncontrast MR imaging
Retrocalcaneal bursitis	Pain in posterior heel near calcaneal insertion of Achilles tendon; common in runners	Pain with passive dorsiflexion and eversion of the foot	Noncontrast MR imaging, plain radiography
Neurogenic Origin			
Tarsal tunnel syndrome	Pain radiating from the medial malleolus into the foot, which may worsen throughout the day; improves with rest of intrinsic foot muscles	Plantar paresthesias elicited by tapping the tibial nerve behind the medial malleolus (Tinel sign); plantar sensory loss or atrophy	Electrodiagnostic studies, MR imaging, US
LPN/MCN entrapment	Plantar foot pain consistent throughout day	LPN: tender over lateral plantar aspect of foot; possible atrophy of abductor digiti minimi. MCN: tender over plantar aspect of medial arch; no muscle atrophy	Electrodiagnostic studies, MR imaging, US
S1 radiculopathy	Radiating pain traveling down the posterior aspect of leg	Diminished ankle jerk reflex and weakened plantar flexion of foot; weakened toe walking	Electrodiagnostic studies, MR imaging, US
Peripheral neuropathy ^c	Risk factors for peripheral neuropathy ^c ; gradual onset of diffuse pain, numbness or tingling in foot that may progress to sharp, jabbing pain	Decreased sensation to vibration, light touch, temperature, and pain, hair loss, smooth skin, muscle atrophy, ulceration, and progressive clawing of toes	Electrodiagnostic studies, nerve biopsy, noncontrast MR imaging, US

^a A positive squeeze test finding would not occur in patients with plantar fasciitis.³

^b Plain radiographs may reveal degenerative changes, including joint space narrowing and marginal osteophyte formation.²

^c Peripheral neuropathy is a condition that is most commonly associated with diabetes but also can result from alcohol abuse and other metabolic deficiencies.³ The diagnosis of peripheral neuropathy is made clinically, and it infrequently requires the use of further imaging.

Abbreviations: LPN, lateral plantar nerve; MCN, medial calcaneal nerve; MR, magnetic resonance; MVA, motor vehicle accident; S1, first sacral vertebra; US, ultrasonography.

domized, prospective clinical trial, corticosteroid injections provided better relief of plantar fasciitis symptoms at 1 month but not at 6 months when compared with control groups.³² The risks associated with corticosteroid injection include skin and fat pad atrophy, infection, and plantar fascia rupture.^{32,33} In a retrospective study, corticosteroid injections were associated with a 10% incidence of plantar fascia rupture.³³ This complication can be serious, possibly leading to problems associated with the loss of the medial longitudinal arch of the foot.³⁴

There are limited data available regarding ESWT for the management of plantar fasciitis. Its therapeutic mechanism is unknown. Nonetheless, in a randomized, double-blinded clinical trial, the addition of 1 application of 3800 high-energy shock waves to standard therapies demonstrated a statistically significant improvement in symptoms at 3 months compared with standard therapies without ESWT.³⁵

Ultrasound therapy has recently been investigated for the management of refractory plantar fasciitis.^{36,37} Although there is presently insufficient evidence to support its efficaciousness, studies suggest it is relatively safe.

Surgical

Partial or complete plantar fasciotomy is indicated only after at least 6 to 12 months of conservative treatment has failed.² Before proceeding with surgery, the differential diagnosis must be revisited to consider other causes of subcalcaneal pain (Table). Surgical release of greater than 40% of the plantar fascia may have detrimental effects on other ligamentous and bony structures in the foot.³⁸ Nevertheless, Davies and colleagues³⁹ reported that 75% of patients who underwent surgical intervention after failed conservative treatment reported substantial or complete reduction in heel pain.

Suggested Treatment Plan

Conservative treatment should first be initiated (Figure 2). Patients should limit activity by level of tolerance and modify footwear (eg, avoid flip-flops and sandals, use

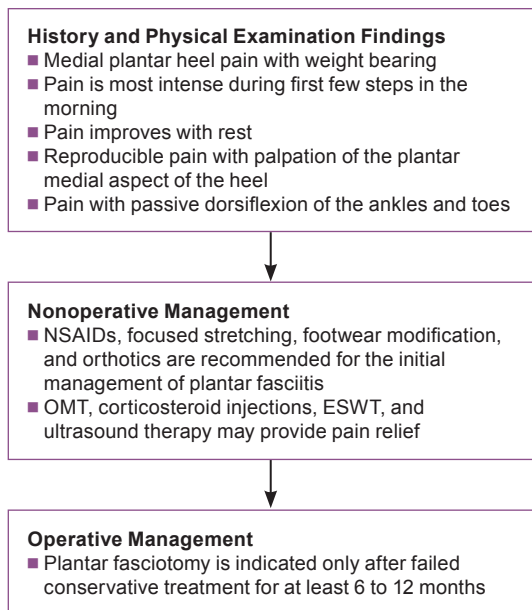


Figure 2. Take home points: diagnosis and management of plantar fasciitis. *Abbreviations:* ESWT, extracorporeal shock wave therapy; NSAIDs, nonsteroidal anti-inflammatory drugs; OMT, osteopathic manipulative treatment.

OTC shoe inserts). Also, a plantar fascial stretching regimen should be initiated, as follows:

- **Wall push:** With the heel on the ground and ball of foot on the base of a wall, the patient leans into the wall to stretch the plantar fascia for at least 2 minutes at 10-second intervals on the affected side at least 2 times daily. (The condition will improve much more rapidly if the patient can do 3 sets of wall pushes every hour on the hour.)
- **Towel pick-up:** With the toes of the affected foot, the patient picks up a dry paper towel, drops it, and repeats for 2 minutes once daily in the evening.
- **Ice roll:** The patient rolls the foot over the top of a frozen water bottle for 2 minutes once daily in the evening.

Outcomes with home stretching alone are excellent after treatment for half the amount of time that symptoms have been present. For example, symptoms present for 1 year would get good results after 6 months of treatment.

If conservative treatment is not effective, moderate treatment consisting of custom orthoses, night splints, and judicious use of injection therapy should be tried. If moderate measures fail, if the symptoms have lasted more than 1 year, and if the patient has been fully compliant with the multiple daily stretching routine, surgery may be required.

Summary

The plantar fascia is subject to chronic repetitive stress at its origin, and plantar fasciitis is one of the most common causes of heel pain. The diagnosis is often made clinically based on the location of pain at the medial calcaneal tubercle. Risk factors include age, female sex, obesity, prolonged weight bearing, and repetitive activities that cause strain on the plantar fascia. Imaging may be necessary to rule out other causes of heel pain in the differential diagnosis after nonsurgical treatment has failed or after the patient presents with atypical pain.

A combination of conservative treatments is successful in most cases and should include NSAIDs, a proper stretching regimen, night splints, and, if there is no relief after 6 to 12 months, referral to a specialist. Short-term relief may be provided by OMT and foot orthoses, but there is no evidence of these modalities providing long-term improvement. Surgical treatment should only be considered if all other methods fail.

Author Contributions

Dr Thompson, Student Doctor Saini, and Drs Reb and Daniel provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; drafted the article or revised it critically for important intellectual content; and gave final approval of the version of the article to be published.

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