

Plantar Fasciitis

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(*Clin J Sport Med* 2004;14:305–309)

Plantar fasciitis affects an estimated 2 million persons who present annually for medical treatment.¹ Runners comprise over 76% of athletes with this condition.^{2,3} Men and women appear to be equally affected.⁴ Plantar fasciitis classically presents as medial heel pain that is sharp and most severe with the first step out of bed in the morning or after prolonged rest. This condition is generally self-limiting, but complete resolution may take 6 to 18 months or longer.⁵ Aggressive management using combination therapies is most efficacious and affords athletes the best opportunity to recover quickly and fully. An understanding of risk factors and pathophysiology will help in identifying athletes predisposed to developing plantar fasciitis, as well as in formulating the most effective preventive and therapeutic treatment plan.

RISK FACTORS

Plantar fasciitis can occur acutely, as with trauma, but more often presents as chronic plantar foot pain of insidious onset associated with chronic overload. In approximately 85% of patients, the etiology is undetermined.^{6,7} Risk factors for developing plantar fasciitis can be divided into anatomic, biomechanical, and environmental and are presented in Table 1. Limited ankle dorsiflexion ($\leq 10^\circ$) has been reported as the most important independent risk factor.⁸ This limitation may cause compensatory excessive pronation of the subtalar joint, which increases the tensile load to the plantar aponeurosis.⁹

PATHOPHYSIOLOGY

Plantar fasciitis has been referred to as *heel pain syndrome* and *heel spur syndrome*, because the pain is usually localized to the insertion of the plantar aponeurosis at the me-

dial tubercle of the calcaneus. The plantar fascia extends from this tubercle to the metatarsal heads, forming the longitudinal arch that provides support for the foot. Excessive load or tension on this aponeurosis can lead to the condition commonly referred to as *plantar fasciitis*. Historically, plantar fasciitis has been considered an inflammatory process. However, in recalcitrant cases, it appears that a degenerative process affecting collagen⁵ or *degenerative fasciosis*¹⁰ occurs without evidence of inflammation. Lemont et al¹⁰ performed histologic examination of surgical biopsies, revealing increased fibroblasts, ground substance, and vascularity, not the expected inflammatory mediators.^{5,10} This improved understanding may impact the use of anti-inflammatory therapies for chronic plantar fasciitis.

TREATMENT

Treatment should be aggressive, should be initiated as early as possible, and should include a multifaceted approach that addresses underlying anatomic and biomechanic conditions, training errors, and risk factors. Assessment of underlying risk factors is the foundation for successful treatment and prevention. Treatment options discussed are summarized in Table 2.

Relative Rest

Relative rest must be a part of the treatment plan, allowing athletes to continue to train in some capacity without exacerbating symptoms. Relative rest relieves microtrauma caused by repetitive overload. Wolgin et al¹¹ reported 25% of patients citing rest as the treatment that best relieved pain. Cross-training should be considered to maintain aerobic fitness levels. Relieving the overuse component through rest is critical to the prevention of further injury.

Stretching

Stretching is the single most effective method of treatment. Of the 83% of patients who improved with stretching, 29% indicated that stretching was most effective in relieving pain as compared with other modalities.¹¹ Stretching should include techniques targeted at the entire lower extremity, especially the plantar fascia and gastrocnemius-Achilles complex.

The athlete can target the plantar fascia at home using a tennis ball, golf ball, or 15-oz can rolled under the arch to provide an adequate stretch. To accentuate further the stretch on

Received for publication February 2004; accepted May 2004.

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TABLE 1. Classification of Risk Factors for Plantar Fasciitis

Anatomical Risk Factors	Biomechanical Risk Factors	Environmental Risk Factors
<ul style="list-style-type: none"> • Pes planus • Pes cavus • Obesity • Tarsal coalition • Leg length discrepancy • Fat pad atrophy • Shortened Achilles tendon 	<ul style="list-style-type: none"> • Equinus • Weak plantar flexor muscles • Weak intrinsic muscles of the foot • Excessive subtalar joint pronation • Poor footwear • Limited ankle dorsiflexion 	<ul style="list-style-type: none"> • Trauma • Deconditioning • Hard surfaces • Walking barefoot • Prolonged weight-bearing • Inadequate stretching

the fascia, the athlete can rest the affected foot on the contralateral or unaffected thigh, applying firm dorsiflexion of the great toe, thus increasing the stretch of the plantar fascia (Fig. 1).¹² Manual stretching techniques such as myofascial release and deep tissue massage can be used to stretch the fascia.

Stretching the gastrosoleus-Achilles complex is achieved using wall stretches with a straight knee to isolate the gastrocnemius muscle and with a bent knee to target the soleus muscle. These stretches can also be performed using a curb or stair. Stretching techniques focusing on the plantar fascia has been shown to accelerate recovery time and is more effective than those directed exclusively at the gastrosoleus-Achilles complex.¹² Early prescriptions should be given for a home stretching program and possibly for physical therapy referral. Specific stretching techniques appear in Table 2.

Night Splints

Dorsiflexion night splints (90°) relieve pain by providing continuous passive stretching during rest and sleep. Their

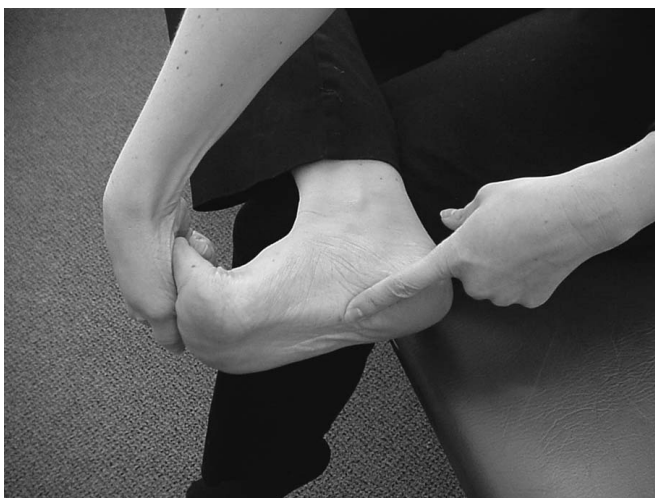


FIGURE 1. Effective stretching of the plantar fascia accomplished by applying firm dorsiflexion of the great toe. Left index finger points at the medial aspect of the stretched fascia.

use may decrease duration of symptoms, and they can be purchased without a prescription. Powell et al¹³ reported that 88% of patients using night splints for 1 month experienced improvement in their symptoms. They can be bulky and uncomfortable but may return the athlete to peak performance more quickly. Frequently, night splints are reserved for recalcitrant plantar fasciitis; we propose that they be considered at the onset of symptoms in athletes.

Strengthening

Plantar flexor muscle strength deficits were cited by Kibler et al¹⁴ as contributing to plantar fasciitis. Martin et al¹⁵ reported that strengthening exercises provide the greatest decrease in pain in 34.9% of patients with plantar fasciitis. Strengthening exercises for the intrinsic muscles of the foot are designed to improve longitudinal arch support and decrease stress on the plantar fascia.

Athletes can perform strengthening exercises every hour throughout the day by simple tapping of the toes with the foot planted. The desired technique is to raise the toes and press them each individually to the floor. Additionally, with a towel placed on the floor, the athlete is instructed to keep the heel planted and gather the towel by curling the toes. As strength improves, weight can be added to the towel to increase resistance.

Strengthening of the gastrosoleus-Achilles complex is accomplished using heel raises. The athlete begins with both legs at once and progresses to single leg repetitions. As strength improves, resistance can be increased using dumbbells or free weights. We recommend that athletes perform strengthening exercises 3 times per day with 12 to 15 repetitions per set. Pain should be monitored with modifications in frequency and intensity to avoid exacerbation or return of symptoms.

Anti-inflammatory Therapies

Recent histologic evidence identifying collagen degradation, as opposed to inflammatory markers in surgical biopsy specimens, raises questions about the utility of anti-

TABLE 2. Treatment Options for Plantar Fasciitis

Treatment	Benefit	Comments
Relative rest	Decrease pain, slow degenerative process	Cross-training to maintain fitness
Stretching	Increase mobility of plantar fascia Decrease tension of gastrocnemius-Achilles complex	Plantar fascia: 15-oz can rolled under arch, cross-friction massage, great toe extension, towel stretch Gastrocnemius: slant board, wall stretch, curb or stair stretch
Night splints (90°)	Prolonged passive stretch	Commercially available, compliance difficult
Strengthening	Improve structural integrity of longitudinal arch Improve plantar flexor strength	Toe curls Toe taps Heel raises
Anti-inflammatory agents		
NSAIDs	Pain control	Short course Risk of GI problems
Ice	Local pain control	15 minutes 2–3 times day
Iontophoresis	Decrease inflammation, local pain control	Time-consuming, reserve for elite athletes or laborers
Corticosteroid injections	Decrease inflammation, local pain control	Use in later stages, risk of plantar fascia rupture, atrophy
Arch supports		
Arch taping	Stabilize midfoot structures	Inexpensive, trial modality
OTC arch supports	Stabilize midfoot structures	Mild pes planus Adolescents experiencing rapid growth Symptoms less than 8 weeks
Customs orthotics	Stabilize midfoot structures Correct anatomical problems	Ideal for anatomical problems Expensive
Shoes	Correct anatomical and biomechanical factors	Change shoes every 300–500 miles Check for correctable problems
ESWT	Induce inflammatory response Increase neovascularization	High-energy: single treatment, local anesthesia needed Low-energy: multiple treatment sessions, no anesthesia needed, standardization still needed
Surgery	Pain control	Failed conservative therapy at least 6 months, often much longer

inflammatory therapy such as NSAIDs for chronic plantar fasciitis.^{5,10} While NSAIDs are effective in some patients and were reported in 1 study to be the most effective treatment by 11% of subjects,¹¹ the use of NSAIDs should be limited to a brief duration. Specifically, this may be 1 to 2 weeks at a time during the most acute flare-ups.

Ice applied to the attachment of the aponeurosis following activity can decrease pain and inflammation. At home, the athlete can use ice massage to stretch the fascia. Iontophoresis can be used to deliver corticosteroid such as dexamethasone to the deep plantar aponeurosis. Gudeman et al reported improvement after 2 weeks but no long-term difference at 6 weeks.^{16,17} Difficulties with this treatment are the time requirement and expense, as optimal therapy requires administration 2 to 3 times per week by a qualified professional. Recommendations are to reserve iontophoresis for elite athletes and laborers prevented from working due to symptoms.¹⁶

Corticosteroid injections are controversial and are not a first-line therapy due to the associated risks and possible complications. They should be reserved for recalcitrant cases of

plantar fasciitis. Studies have shown a 70% success rate using steroid injections when applied early in the disease process.^{7,18} Injections can be performed using a plantar or medial approach with or without ultrasound guidance. Complications include rupture of the plantar fascia and fat pad atrophy. Although rupture of the plantar fascia is uncommon, injection of corticosteroids has been suggested as a contributing factor.^{3,19,20} Most patients had resolution of symptoms associated with rupture within 6 to 8 weeks.^{3,21} Still, the use of corticosteroid injections in plantar fasciitis remains controversial.

Arch Supports

The longitudinal arch is designed to distribute forces generated at heel strike. Anatomic, biomechanical, and environmental factors causing abnormal distribution of these forces can result in plantar fasciitis. Arch supports, through taping or orthoses, can alter the transmission of forces and decrease stress. As a simple noninvasive treatment, they can be considered a first-line treatment of plantar fasciitis in combination with a stretching program.

Arch taping is also a simple, cost-effective treatment of plantar fasciitis. In patients with pes planus or pes cavus, a single arch taping treatment is less expensive than over-the-counter (OTC) arch supports. It is also useful as a treatment trial. If arch taping relieves pain, then advancing to an OTC or custom-made orthotic should be considered.

Patients with mild pes planus may benefit from OTC arch supports.²² They are useful for pediatric athletes who experience rapid foot growth, making custom orthotics cost-prohibitive. OTC arch supports coupled with a formal stretching program offer greater benefit than custom-made orthotics for the initial treatment of plantar fasciitis of duration less than 8 weeks.²³

In patients with plantar fasciitis of duration greater than 8 weeks, the use of custom orthotics may be efficacious.²³ In a pilot study of 15 patients with a mean age of 44 years and plantar fasciitis with a duration of 21 months, semirigid custom orthotics significantly improved pain and functional disability scores by 66% and 75%, respectively.²⁴ Custom orthotic devices for plantar fasciitis are commonly semirigid, covering 3/4 to the entire foot.^{24,25} They have been extremely effective in controlling overpronation, first metatarsal head motion, pes planus, valgus heel alignment, and leg length discrepancies, all of which may be risk factors for this condition.

Shoes

Shoes that are properly fitted with well-supported arches and midsoles can absorb forces transmitted through the foot during walking and prolonged standing. Athletes should be encouraged to limit time spent walking barefoot or in sandals. Some popular recommendations for footwear include using shoes with a minimal 1" heel height and a stable midfoot shank, as recent shoe design changes utilizing a 2-piece outsole may contribute to developing plantar fasciitis.²⁶ These design changes result in weaker midsoles that increase stress on the plantar fascia and thus should be avoided.

A simple change in shoes is reported to improve symptoms in 14% of patients with plantar fasciitis.¹⁵ Runners should replace their shoes every 300 to 500 miles because of an older shoe's tendency to provide inadequate support.

Extracorporeal Shock Wave Therapy

Extracorporeal shock wave therapy (ESWT) is delivered as acoustic waves that propagate rapidly in 3-dimensional space and cause a sudden rise in pressure at the wave front (i.e., medial tubercle of the calcaneus).^{27,28} The intent is to elicit an inflammatory response that promotes neovascularization and healing. In most studies using ESWT, success is defined as 50% reduction in pain. It is customarily given as either 3 moderate-energy treatments given over a 3-week period requiring no anesthesia or as a single high-energy treatment requiring regional anesthesia.

A review of current literature suggests that moderate-energy ESWT given over several sessions is an ineffective treatment.^{4,29,30} However, using single high-energy treatment, Alvarez³¹ reported that at 12 months, 20 of 20 patients met criteria for success, and 65% were pain-free at 24 months. This brings up the main point of controversy surrounding this treatment: whether single high-energy treatments will ultimately prove effective when repeated moderate-energy doses have not. The US FDA granted approval of electrohydraulic devices for single high-energy use in chronic proximal plantar fasciitis.³² However, more research is needed to support the use of single high-energy ESWT in this condition. When considered, ESWT use should be limited to patients who have had pain for at least 6 months and have not satisfactorily responded to conservative management strategies including stretching, strengthening, orthoses, and corticosteroid injections.

Surgical Treatment

Surgical intervention has been the last resort for the 5% of all patients with plantar fasciitis who have failed all other options.³³ In general, the success rate for surgical intervention is quite high. In some studies, over 90% achieved a satisfactory functional outcome.³⁴ Generally, the surgical approach, open or endoscopic, involves transection of the plantar aponeurosis. Complications of surgical procedures include flattening of the longitudinal arch and heel hypoesthesia.

SUMMARY

Athletes should be educated about the symptoms of plantar fasciitis and advised to seek medical attention early so that aggressive mechanical management may be implemented and the duration of condition shortened.

Athletes are highly motivated to return to competition, and those with plantar fasciitis will benefit most from a multifaceted approach to treatment, including a good home exercise program. Management should be directed toward treating underlying causes (e.g., pes planus) and implementing an aggressive plan of relative rest, stretching, and strengthening. Physical therapy should include manual techniques directed specifically to the plantar fascia and consideration of modalities such as iontophoresis. Nonsteroidal anti-inflammatory therapies can be beneficial in acute plantar fasciitis, but corticosteroid injections should be used with caution due to the increased risk of rupture of the fascia. There is burgeoning evidence to support collagen degeneration and not inflammation as the primary pathology of recalcitrant plantar fasciitis. ESWT provides a nonsurgical option for athletes with plantar fasciitis of duration at least 6 months resistant to aggressive home and physical therapy. Plantar fasciotomy and other operative procedures should be reserved for athletes who have failed all other therapies.

ACKNOWLEDGMENT

The authors thank Lenora M. Adams, BA, MSIV, for her assistance in preparation of the manuscript.

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