

Management Options for Plantar Fasciitis

Plantar fasciitis, a common over use injury, is characterized by heel pain that is usually more severe when the patient first arises. Frequent precipitating factors include ad- verse foot mechanics, training errors, and degenerative changes. Management of plantar fasciitis is a three-part process that involves treating the inflammatory lesion, correcting precipitating factors, and instituting a graduated rehabilitation program. Use of the tension night splint has shown promising results.

By: Mark E. Batt, MB, BChir and Jeffrey L. Tanji, MD

Plantar fasciitis, a major cause of heel pain in athletes and nonathletes, is caused by repetitive strain. As is typical of any overuse injury, it may present as an acute problem or develop into a protracted chronic lesion. Plantar Fasciitis accounts for 7% to 9% of running injuries (1,2). People active in other sports that require repetitive push-off motions, such as tennis, basketball, soccer, and gymnastics, are also vulnerable.

Originally described in 1812 and incorrectly attributed to tuberculosis, plantar fasciitis has been described as painful heel syndrome, painful heel spur, calcaneodynia, subcalcaneal pain, medial arch sprain, stone bruise, and calcaneal periostitis (3). The condition is an overuse traction enthesopathy of the plantar fascia.

How Plantar Fasciitis Develops

The plantar fascia forms an important secondary restraint in the foot, helping to maintain the medial longitudinal arch by tensing like a bowstring on the plantar surface. During the normal gait cycle, the foot pronates to absorb pressure from heel strike and then supinates to form a rigid lever-arm for toe-off. The plantar fascia acts as part of the shock-absorbing mechanism of the foot and, during toe-off, as a foot stabilizer aiding the locking of the midtarsal joints.

During running, the stance phase of the gait is reduced, but the force generated with each heel strike is two to four times that of body weight and occurs 800 to 2,000 times per mile run (5). Overuse injuries are thus to be expected, particularly when biomechanical abnormalities exist. According to Kibler, many overuse injuries result from tissue overload associated with a functional adaptation or biomechanical deficit (6).

The characteristic lesion of plantar fasciitis is an enthesitis-inflammation at the bone-ligament (fascial) interface-that results from tensile overload of the plantar fascia insertion on the medial calcaneal tuberosity. Initially, this repetitive microtrauma manifests as an acute inflammatory lesion. But with persistent overuse, it can become a chronic condition characterized by destructive collagen changes (6,7). Surgical examination may reveal chronic granulation tissue consistent with tendinosis, which histologically consists of mucinoid degeneration, collagen necrosis, angiofibroblastic hyperplasia, and matrix calcification (3,8).

Characteristic Pain

The classic history of plantar fasciitis is marked by the insidious onset of sharp pain at the fascial insertion on the plantar surface of the anteromedial calcaneus. The onset of pain is generally not associated with any one specific event. The pain is usually more severe when the patient first arises; a tearing sensation may accompany the patient's first few steps. During the initial stages of exercise, the symptoms are more pronounced, easing as exercise continues. This alteration reflects the degree of stiffness and contracture in the plantar fascia (9).

Initially, the pain, which the patient may describe as burning, may occur only at the medial tuberosity of the calcaneus and with exercise. With progression, pain may start interfering with activities of daily living and be experienced more distally along the medial aspect of the fascia.

Plantar fasciitis is a clinical diagnosis. Examination reveals exquisite local tenderness at the anteromedial calcaneus, which may spread along the fascia. Passive dorsiflexion of the toes or having the patient perform heel raises may exacerbate the pain.

Table 1: Precipitating Factors for Plantar Fasciitis

Overuse

- Training Error
- Increased volume
- Increased intensity
- Hill running

Poor Equipment

Adverse Biomechanics

- Hyper-pronation
- Talipes carvus
- Pes planus
- Externally rotated lower limb

- Leg length discrepancy

Poor Strength and/or Flexibility

- Tight and/or weak triceps surae
- Tight Achilles tendon

Degenerative Change

- Heel fat pad flattening
- Aging

Systemic Disorders

- Sero-negative spondylarthritis
- Reiter's syndrome
- Ankylosing spondylitis
- Rheumatoid arthritis
- Gout
- Nutritional osteomalacia

Watch for Precipitating Factors

During the history and physical exam, the physician should be alert to common precipitating factors (Table 1). A combination of factors is generally involved in the development of plantar fasciitis (10,11). Training errors, particularly excessive mileage or sudden volume increase, are commonly implicated.

Another common factor is adverse foot biomechanics. Hyperpronation, which tends to progress with age, produces excessive stretching of the plantar fascia because of a prolonged midstance phase of gait with delayed and unsupported toe-off. High-arched feet dissipate stress poorly, producing increased stress in the foot during the gait cycle. Conversely, flatfoot resulting from weak arch and foot ligaments produces increased strain in the secondary supporting structures of the foot (12).

Diagnostic Testing

The role of x-rays in the evaluation of plantar fasciitis remains controversial. Hindfoot x-rays are probably not useful as a preliminary diagnostic test for patients who have short-lived symptoms as bone spurs also occur in asymptomatic patients. Early in the condition, no changes are generally seen, but fluffy changes at the enthesis may occur later (13). Bone spurs are frequently seen, but in the absence of significant fat pad atrophy, they are probably not the primary cause of pain. Exceptions include down-pointing spurs and bone spurs that are associated with plantar fasciitis and seronegative arthropathy; in the latter case, bone spurs may be associated with characteristic erosive changes (14,15).

Although a concordance exists between seronegative spondylarthritis and

plantar fasciitis (and consequently between HLA-B27 positivity and plantar fasciitis), human leukocyte antigen typing should not be routine. Bone scans should also not be routine but may be useful in difficult cases or when a stress fracture is suspected. Bone scan scintigraphy can supply an objective benchmark for the patient's response to therapy (16).

Table 2: Precipitating Factors for Plantar Fasciitis

Tarsal tunnel syndrome
Plantar fascia rupture
Calcaneal stress fracture
Fat pad degeneration or trauma
Tenosynovitis
Flexor hallucis longus
Flexor hallucis brevis
Tendonitis
Peroneus longus
Tibialis posterior
Sero-negative spondylarthritis
Reiter's syndrome
Ankillosing spondylitis
Rheumatoid arthritis
Gout
Nutritional osteomalacia

Differential Diagnosis

Although the differential diagnosis of heel pain (calcaneodynia) is extensive, the differential diagnosis for anteroinferior heel pain is more contained (Table 2).

Tarsal tunnel syndrome is entrapment of the posterior tibial nerve or one of its three branches in the fibro-osseous tunnel posterior to the medial malleolus. In distinction from plantar fasciitis, the pain is characterized as a burning dysesthesia in the distribution of the affected nerve and is exacerbated by exercise. Nocturnal pain and a positive Tinel's sign may also aid the diagnosis (17).

Partial rupture of the plantar fascia is associated with an acute event and produces sudden onset pain, swelling, and subsequent bruising. This injury may be associated with prior injection of steroids (18).

Runners who maintain a high weekly mileage or rapidly increase their mileage are susceptible to stress fracture of the calcaneus. Unlike the pain of plantar fasciitis, which typically diminishes with activity, stress fracture pain characteristically crescendos with exercise.

The coexistence of a systemic disorder also deserves consideration. Plantar fasciitis may be the first symptom of or a complication of rheumatoid arthritis, gout, or seronegative spondylarthritis such as Reiter's syndrome and ankylosing spondylitis (14). Nutritional osteomalacia is another systemic condition that can be present with plantar fasciitis (19).

Three-Step Approach

Management of plantar fasciitis requires recognition that, like other overuse injuries, plantar fasciitis can be a short-lived inflammatory condition or develop into a more chronic lesion. Acute uncomplicated cases may be successfully managed with conservative modalities. Treatment must address three areas: the traction enthesitis and accompanying inflammation, the inciting factors, and rehabilitation needs.

Addressing inflammation

In acute cases of plantar fasciitis, a significant inflammatory reaction is present. Relative rest and a nonsteroidal anti-inflammatory agent may be used as first-line treatment. Relative rest involves continuing activities at reduces intensity or duration and avoiding actions liable to exacerbate the condition such as prolonged walking, running, or jumping. Physical therapy modalities such as ice and ultrasound may also be useful.

Countering inciting factors

Use of appropriate footwear for both everyday activities and sport is obvious but much-neglected self-help advice. An antipronatory shoe (straight last with good hindfoot control) is preferable. Running shoes should be flexible at the ball of the foot but not in the middle of the arch.

A heel orthosis (notably a simple heel cushion) can provide shock attenuation at heel strike as well as weight redistribution (20). The heel raise also reduces the significance of a tight triceps surae; at heel strike this tightness causes calcaneovalgus structures of the foot. Patients who have adverse foot benefit from ridge, semirigid, or flexible orthoses (21).

Training adaptations may also be necessary; for example, runners whose overuse injury was brought on by excessive or accelerated mileage and hill running should reduce intensity and mileage.

Rehabilitation measures

Adequate rehabilitation is essential to the management of plantar fasciitis and should begin as soon as inflammation and pain have begun to subside, which may vary from a few days to a few weeks. Stretching the Achilles tendon and triceps surae with ankle dorsiflexion exercises is necessary to

restore ankle range of motion. Also required is strengthening the triceps surae and foot intrinsic muscles, starting with isometric activity and progressing to isotonic and functional activities. A study that demonstrated static and dynamic range of motion deficits in addition to reduced peak torques in the ankles of patients with plantar fasciitis highlights the importance of this approach (22).

Once specific precipitating factors have been identified and corrected, functional rehabilitation should include the entire kinetic chain from the foot through the ankle and knee to the hip.

Tension Night Splint

Recently, use of the tension night splint has been advocated for the treatment of plantar fasciitis (23, 24).. The splint allows the plantar fascia to heal at a functional length during sleeping hours. The first night splint was a custom-molded polypropylene ankle-foot orthosis (23). A less expensive splint, which can be easily constructed in the office, runs posteriorly from below the knee to the ankle and then beyond the toes.

Whether the patient lies supine or prone during sleep, the foot adopts a plantar-flexed position which relaxes the plantar fascia. The tension night splint counteracts this natural tendency by maintaining ankle dorsiflexion and toe extension and, thus, tension within the plantar fascia during sleep.

On arising, the patient removes the splint and performs gentle foot stretches and intrinsic muscle exercises (e.g. towel rolling). Splint use significantly reduces early morning pain, which probably reflects functional healing. The patient gradually weans from the splint by using it on alternate nights once symptoms resolve. It may be used again if the patient feels a recurrence of symptoms. The splint is typically well tolerated and may be used in conjunction with other conservative modalities.

A retrospective pilot study using an easily constructed tension night splint for 20 patients who had acute or chronic disease demonstrated significant healing rates (24). A prospective randomized clinical trial to assess the usefulness of the splint in the treatment of acute and chronic pain had shown similar promising results (25).

Care for Chronic Pain

Chronic plantar fasciitis can be difficult to manage, and prolonged treatment may be required. Use of nonsteroidal anti-inflammatory drugs and stretching exercises can continue.

Orthoses

Orthoses prescribed in the acute phase may still be appropriate, or adaptation may be necessary. Taping the arch of the foot and subsequent use of a custom-made orthosis may be useful in patients who hyperpronate (13). By limiting pronation, a custom-made orthosis may be useful in patients who hyperpronate. By limiting pronation, a custom-made shoe insert can help reduce overstretching of the plantar fascia. Because this requires making a positive from a custom-casted plaster wrap and is therefore relatively expensive, it is best reserved for patients with disease unresponsive to standard measures (26).

Long-term use of heel raises or cups may be appropriated for patients who have heel fat pad destruction. In these patients, who are frequently older or overweight, the disease is often resistant to treatment.

Corticosteroid injection

Corticosteroid injection for plantar fasciitis is controversial because it may contribute to acute rupture of the plantar fascia (18). Whether such ruptures occur in an already pathologically weak plantar fascia or in a plantar fascia weakened by steroid is conjectural. However, steroid injection is probably best reserved for recalcitrant cases. The injection approach may be medial or lateral; care should be taken to avoid the fat pad. A few days rest is advised following the procedure (9).

Surgery

Reports from Egypt and China discuss using calcaneal drilling as a pain-relieving measure through release of calcaneal pressure (27). More conventionally, resistant plantar fasciitis has been treated surgically with plantar fascia release and excision of the calcaneal spur if present. Postoperatively, patients wear a short-leg cast and, after cast removal, engage in an active stretching program (3,8). Histologic findings demonstrate a chronic granulomatous response similar to that seen in lateral epicondylitis.

Success of plantar fascia release is varied but generally good: Recent series report good or excellent results in 88% to 100% of patients treated for chronic, unresponsive disease (8,15,28). Optimism about a return to former sporting activities is warranted.

Other options

Historically, treatment options for chronic plantar fasciitis have included casting and radiotherapy, neither of which is currently regarded as first- or second-line therapy (2,29).

Stepping Away from Pain

Active patients who have plantar fasciitis can often return to pain-free activity, even if they have had chronic plantar fasciitis. Return to activity should occur gradually within the bounds of pain. A stretching and strengthening program can help prevent the onset or recrudescence of this condition, as can proper footwear. Patients should also avoid provocative activities. Those patients who have found orthoses or heel supps useful in recovery may also find them helpful preventive measures as well.

References

1. James SL, Bates BT, Ostering LR; Injuries to runners. *AM J Sports Med* 1978;6 (2):40-50
2. McBryde MA Jr: Plantar Fasciitis. *Instructional Course Lectures* 1984; 33:278-282
3. Leach RE, Seavey MS, Salter DK: Results of surgery in athletes with plantar fasciitis. *Foot Ankle* 1986; 7 (3): 156-161
4. Taunton JE, Clement DB, McNicol K: Plantar Fasciitis in runners. *Can J Appl Sport Sci* 1982;7 (1):41-44
5. Brody DM: Running injuries: prevention and management. *Clin Symp* 1987; 39 (3):1-36
6. Kibler WB: Clinical aspects of muscle injury. *Med Sci Sports Exerc* 1990; 22 (4): 450-452
7. Perry JD: Exercise, injury and chronic inflammatory lesions. *Br Med Bull* 1992 ; 48 (3):668-682
8. Snider MP, Clancy WG, MvBeath AA: Plantar Fascia release fro chronic plantar fasciitis in runners. *Am J Sports Med* 1983; 11 (4): 215-219
9. Kwong PK, Kay D, Voner RT, et al: Plantar Fasciitis: mechanics and pathomechanics of treatment. *Clin Sports Med* 1988; 7 (1): 119-126
10. Warren BL: Anatomical factors associated with predicting plantar fasciitis in long-distance runners. *Med Sci Sports Exerc* 1984; 16 (1): 60-63
11. Warren BL, Jones CJ: Predicting plantar fasciitis in runners. *Med Sci Sports Exerc* 1987; 19 (1): 71-73
12. Warren BL: Plantar fasciitis in runners: treatment and prevention. *Sports Med* 1990; 10 (5): 338-345
13. Newell SG, Miller SJ: Conservation treatment of plantar fascial strain. *Phys Sportsmed* 1977; 5 (11): 68-73
14. Gerster JC: Plantar fasciitis and Achilles tendonitis among 150 cases of seronegative spondarthritis. *Rheumatol Rehabil* 1980; 19 (4): 218-222
15. Schepsis AA, Leach RE, Gorzyca J: Plantar fasciitis: etiology, treatment, surgical results and review of the literature, *Clin Orthop* 1991; 226 (May): 185-196
16. Sewell JR, Black CM, Chapman AH, et al: Quantitative scintigraphy in diagnosis and management of plantar fasciitis

- (calcaneal periostitis): concise communication. *J Nucl Med* 1980; 21 (7): 633-636
17. Jackson DL, Haglund BL: Tarsal tunnel syndrome in runners. *Sports Med* 1992; 13 (2): 146-149
 18. Leach R, Jones R, Silva T: Rupture of the plantar fascia in athletes. *J Bone Joint Surg (Am)* 1978; 60 (4): 537-539
 19. Paice EW, Hoffbrand BI: Nutritional osteomalacia presenting with plantar fasciitis. *J Bone Joint Surg (Br)* 1987; 69 (1): 38-40
 20. Levitz SJ, Dykyi D: Improvements in the design of viscoelastic heel orthoses: a clinical study. *J Am podiatr Med Assoc* 1990; 80 (12): 653-656
 21. Roy S: How I manage plantar fasciitis. *Phys Sportsmed* 1983; 11 (10): 127-131
 22. Kibler WB, Goldberg C, Chandler TJ: Functional biomechanical deficits in running athletes with plantar fasciitis. *Am J Sports Med* 1991; 19 (1): 66-71
 23. Wapner KL, Sharkey PF: The use of night splints for treatment of recalcitrant plantar fasciitis. *Foot Ankle* 1991; 12 (3): 135-137
 24. Batt ME, Tanji JL: Plantar fasciitis: the tension night splint. Presented as a pearl of practice at American Medical Society for Sports Medicine/ American Orthopaedic Society for Sports Medicine Current Concepts for the Team Physician, Phoenix, AZ, March 1993
 25. Batt ME, Tanji JL, Skattum N: The tension night splint as a treatment modality for plantar fasciitis. Research presentation at American Medical Society for Sports Medicine annual conference, Hilton Head, SC, April 1995
 26. Campbell JW, Inman VT: Treatment of plantar fasciitis and calcaneal spurs with the UC-BL shoe insert. *Clin Orthop* 1974; 103 (103): 57-62
 27. McConkey B: Policeman's heel, editorial. *Br Med J (Clin Res Ed)* 1981; 283 (6302): 1278-1279
 28. Lester DK, Buchanan JR: Surgical treatment of plantar fasciitis. *Clin Orthop* 1984; Jan (186): 202-204
 29. Mantell BS: Radiotherapy for painful heel syndrome. *Br Med J* 1978; 2 (6130): 90-91