Two million people annually seek treatment for plantar heel pain. The variety of terms used to describe plantar heel pain (eg, plantar fasciitis, plantar fasciosis, and heel spurs) reflects its multifactorial and widely disputed etiology, but these terms do not specify where the pain is felt. For this reason, the term plantar heel pain syndrome is preferred to describe the entity discussed in this article that causes so many people to seek podiatric medical treatment.

This article presents the results of a recent survey of podiatric physicians who are members of the American Academy of Podiatric Sports Medicine. Their current treatment approaches, as reported in the survey, are discussed in light of current theories of plantar heel pain syndrome etiology, published studies of various treatment modalities, and available treatments for this common condition, with a focus on injectable corticosteroids.

**Definition of Plantar Heel Pain Syndrome**

Heel pain affects all aspects of an individual’s life. Weight management, blood pressure, lipid levels, mood, diabetes control, osteopenia and osteoporosis prevention and treatment, and cardiac health are all negatively affected when plantar heel pain syndrome interferes with the ability to walk.

The typical patient with plantar heel pain syndrome presents with pain and tenderness at the site of the attachment of the plantar fascia to the medial process of the calcaneus. Dorsiflexion of the toes increases the pain, whereas plantarflexion causes no pain. The patient may walk on the forefoot to avoid bearing weight on the painful heel. Pain is worst on initial weightbearing in the morning and is also notable after periods of inactivity, after standing on hard surfaces, or with stair climbing. On examination, the patient has tenderness with palpation of the medial calcaneal tuberosity and the medial aspect of the proximal longitudinal arch.

Plantar heel pain syndrome as defined here does not cause pain at the posterior aspect of the heel. Pain at that location is most often related to a pathologic process involving the Achilles tendon. The staging of plantar heel pain syndrome is based on duration of symptoms. In the survey reported on here, the following staging system was used: early stage, duration of less than 7 weeks; intermediate stage, 7 to 24 weeks; and late stage, greater than 24 weeks.
Survey Methods

On September 29, 2004, an electronic mail questionnaire on treatment of plantar heel pain syndrome was distributed to 317 members of the American Academy of Podiatric Sports Medicine enrolled in an e-mail news-distribution system for the membership. Of the 317 eligible podiatric physicians, 48 (15%) responded. The cutoff date for receipt of survey responses was October 29, 2004.

The brief survey was designed to capture general practice information and current management recommendations for the early, middle, and late stages of plantar heel pain syndrome. The survey contained 12 multiple-choice questions and two open-ended requests for comments regarding complications of corticosteroids and additional general comments about treatment of the syndrome. Specific questions were asked about the use of corticosteroid injections in the treatment of plantar heel pain syndrome. Not all of the respondents answered all of the questions; percentages are based on the number who answered each question.

Results

Characteristics of Respondents’ Practices

Forty-eight members of the American Academy of Podiatric Sports Medicine responded to the survey. Most respondents (75%) were in solo or partnership practice arrangements. Seventy-five percent of the respondents had 10 to 24 years of experience in treating patients with plantar heel pain syndrome. They reported that their patients represented a wide payer mix (Medicare, Medicaid, private insurance, health maintenance organizations, and uninsured). For 27% of the respondents, sports medicine constituted more than one-half of their practice, and for another 51%, sports medicine was between one-quarter and one-half of their practice. According to the respondents, the patients who presented to their practices with plantar heel pain syndrome were mostly 30 to 50 years of age, the same general age range as reported elsewhere.3–4

Management of Plantar Heel Pain Syndrome

Current heel pain management ranges from simple patient-directed measures to costly surgical interventions. According to the survey respondents, the preferred treatment modality differed according to the stage and severity of pain.

Early Stage. In the early stage of heel pain, simple measures may eliminate the etiologic factors and the discomfort. Most patients try these simple interventions before seeking podiatric medical care. According to the survey, the most common interventions recommended for early-stage plantar heel pain syndrome are regular stretching of the calf muscles, avoidance of wearing flat shoes and walking barefoot, and use of over-the-counter arch supports. Also commonly used in the early stages are strapping, cryotherapy, and nonsteroidal anti-inflammatory drugs (Table 1).

What is the evidence supporting specific muscle strengthening and stretching exercises as an important component of the treatment of plantar heel pain syndrome, and what kinds of exercise have been studied? Two recent articles describe specific exercise programs used for plantar heel pain syndrome management. DiGiovanni et al5 devised an 8-week structure-specific plantar fascia stretching program that had better outcomes than the standard program of weightbearing Achilles tendon stretching exercises. Bolgla and Malone6 recommended specific exercises based on biomechanical principles deriving from an understanding of the windlass mechanism. These exercises were designed to improve posterior tibial strength, ankle plantar flexor strength, intrinsic foot musculature strength, and proximal hip musculature strength. Data supporting the efficacy of an 8-week gastrocnemius and soleus muscle stretching program were provided in a study by Pfeffer and colleagues.7

Intermediate Stage. Custom Orthotic Devices. When plantar heel pain syndrome symptoms do not respond to simple interventions, 60% of survey respondents would recommend the use of custom orthotic devices (Table 1). An additional 33% would have introduced custom orthotic devices as an early intervention. The almost universal use of custom orthotic devices confirms reports in the literature that successful long-term treatment depends on concomitant use of custom semirigid orthoses and shoes with a firm posterior counter.5 This combination prevents excessive plantar fascial strain by supporting the first metatarsal bone and by controlling calcaneal position.8 Researchers from Texas A&M University studied the effectiveness of three individual mechanical modalities—custom orthoses, over-the-counter arch supports, and tension night splints—in the treatment of plantar heel pain syndrome. Final outcomes were based on first-step pain or pain experienced during the day. No statistically significant differences were noted among treatment groups for final outcomes. However, patient compliance was greatest with the use of custom orthoses.1 A study by Pfeffer et al7 also indicated similar efficacy with custom orthotic devices and soft prefabricated inserts, although there
were indications that the soft inserts might be better for patients who stand for extended periods.

**Corticosteroid Injections.** Corticosteroid injections were almost as widely recommended as custom orthotic devices for the treatment of intermediate-stage plantar heel pain syndrome, with 88% of respondents using this modality (Table 1). Before recommending corticosteroid injections, 88% of respondents said that they would obtain plain film radiographs. Corticosteroid injections are thought to relieve heel pain by modifying the vascular inflammatory response to injury, restricting leukocyte and macrophage accumulation at the lesion, preventing vasoactive kinin release, inhibiting destructive enzyme release, and decreasing prostaglandin formation. 9, 10

Corticosteroid preparations vary in potency, solubility, and fluorination. Higher-solubility, nonfluorinated corticosteroids are considered appropriate for soft-tissue injection because they are less likely to cause atrophy of surrounding tendons, ligaments, and fascia. Only one nonfluorinated product (methylprednisolone acetate) is available in the United States. The duration of effect correlates inversely with the solubility of the preparation. Triamcinolone hexacetonide is the least-soluble (and, therefore, the longest-acting) preparation. 11 Table 2 lists the corticosteroids used by the American Academy of Podiatric Sports Medicine survey respondents.

Single injections into soft tissues or bursae are considered safe, whereas repetitive injections have the potential to cause tendon rupture, fat atrophy, or muscle wasting. However, inadequate doses may not provide effective anti-inflammatory effects. 9, 11 One author 11 recommends 20 mg of methylprednisolone acetate for bursa injections and 5 to 20 mg of methylprednisolone acetate for tendon sheath injections. He cautions against repeating injections in patients who do not benefit or who have short-lasting benefits after one or two injections.

Many survey respondents reported using a short-acting corticosteroid solution and a long-acting corticosteroid suspension diluted with local anesthesia or a long-acting solution diluted with local anesthesia. Most widely used are lidocaine, ethyl chloride spray, and bupivacaine (Marcaine) to provide local anesthesia. Manufacturers' recommendations for dilution vary with different preparations. One survey respondent, who was concerned that corticosteroid preparations might flocculate when mixed with methylparaben preservatives, said that he uses single-dose lidocaine without methylparabens.

The injection approach for plantar heel pain syndrome treatment reported to be used by most respondents (73%) was the medial-to-lateral approach (parallel to the plantar surface above the fascia), presumably to avoid possible pain and scarring of the bottom of the foot. Other mentioned approaches were perpendicular to the plantar surface (17%) and plantar-lateral (at a 45° angle through the fascia to the bursa) (6%) (Fig. 1). This approach avoids the plantar aspect of the heel, which may lessen postinjection discomfort and the formation of painful scar tissue in a weight-bearing area of the foot. One survey respondent reported increased success using diagnostic ultrasound as an injection aid and suggested that the ultrasonography provides a distraction that may reduce perceived pain.

**Efficacy of Corticosteroid Injections.** Data sup-

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**Table 1. Recommended Interventions for Heel Pain from a 2004 American Academy of Podiatric Sports Medicine Survey (N = 48)**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Early Intervention</th>
<th>Intermediate Therapy</th>
<th>Late-Stage Therapy for Resistant Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonsteroidal anti-inflammatory drugs</td>
<td>60</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Regular stretching of calf muscles</td>
<td>88</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Limitation of extended physical activity</td>
<td>44</td>
<td>35</td>
<td>10</td>
</tr>
<tr>
<td>Night splints</td>
<td>25</td>
<td>40</td>
<td>29</td>
</tr>
<tr>
<td>Cast immobilization</td>
<td>0</td>
<td>8</td>
<td>77</td>
</tr>
<tr>
<td>Surgical plantar fasciotomy</td>
<td>0</td>
<td>0</td>
<td>88</td>
</tr>
<tr>
<td>Avoidance of wearing flat shoes and walking barefoot</td>
<td>92</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Custom orthotic devices</td>
<td>33</td>
<td>60</td>
<td>2</td>
</tr>
<tr>
<td>Cryotherapy to the affected part</td>
<td>67</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Over-the-counter arch supports and heel cushions</td>
<td>90</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strapping of the foot</td>
<td>75</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Corticosteroid injections</td>
<td>23</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>Extracorporeal shockwave therapy</td>
<td>2</td>
<td>4</td>
<td>69</td>
</tr>
</tbody>
</table>
porting the use of corticosteroid injections are sparse, although soft-tissue injections are known to provide substantial benefits in tendinitis and bursitis. In refractory cases, corticosteroids injected at the maximum point of tenderness can interrupt the pain-injury cycle. Intramuscular injection of corticosteroids may provide benefits for days or weeks. How corticosteroids are used varies somewhat with the experience of the practitioner. One respondent reported finding corticosteroid injections most effective when administered within 3 months of the onset of heel pain, and several survey respondents recommended restricting activity for at least 24 hours after an injection, which has also been recommended in the literature. Several respondents reported applying casts to immobilize the extremity after injection. Clinical response to corticosteroid injections (with or without adjunct night splints or casts) is expected within 2 to 3 months in 85% to 90% of patients.

Possible Complications of Corticosteroid Injections. When asked to describe complications encountered with corticosteroid injections for heel pain, 27 of 48 physicians responded. The most common complication listed was corticosteroid flare (11 respondents), described as occasional or rare. One survey respondent reported elevated blood glucose levels in diabetic patients injected with corticosteroids. The occasional systemic corticosteroid effect has also been reported in the literature. Survey respondents also reported ecchymosis, increased pain for the first few days after injection, and infrequent cases of fatpad thinning as occasional adverse effects of corticosteroid injections.

Of all of the survey respondents, only six had ever observed plantar fascia rupture in patients after corticosteroid injection. In 1978, Leach et al described plantar fascia rupture in athletes and raised the question of a relationship between repeated corticosteroid injections into collagen tissue and a possible deleterious effect that could lead to rupture. Sellman reported a series of 37 patients with plantar fascia ruptures and previous corticosteroid injections. Most of these patients had been injected with triamcinolone, 20 to 40 mg, diluted with 1.5 mL of lidocaine or bupivacaine. Recovery from plantar fascia rupture is usually complete within 3 to 4 weeks. In a study on recovery from plantar fascia rupture in 18 athletes, podiatric physicians recommended 2 to 3 weeks of non-weightbearing in a high-top or short-leg removable cast-boot along with physical therapy and foot orthoses. Patients returned to athletic activity after 2 to 26 weeks (mean ± SD, 9.1 ± 6.0 weeks), and no negative sequelae were reported.

Late Stage. For patients with resistant heel pain, surgical plantar fasciotomy, long-term casting, and extracorporeal shockwave therapy were the therapeutic modalities most frequently considered (Table 1).

Discussion

Etiology of Heel Pain

The etiology of this common foot problem is multifactorial and the subject of much debate by podiatric and orthopedic physicians. Anatomical, biomechanical, and pathological factors, such as degenerative and inflammatory changes in plantar fascia and subtalar joint, are all thought to play a role. In addition to aging and repetitive stress, other risk factors include obesity, diabetes, and foot deformities. Because of the complex interplay of these factors, it is often difficult to identify a single cause for heel pain.

Having reviewed the experiences of 48 podiatric physicians, we found some interesting patterns in the management of this common problem. First, the use of corticosteroid injections is widespread, with over 80% of respondents using them. However, the frequency and timing of injections varied widely, suggesting that practitioners have developed their own strategies based on their own experiences.

Second, the majority of respondents recommended restricting activity for at least 24 hours after an injection, which is consistent with the literature. This temporary immobilization allows the injection to take effect while minimizing the risk of complications.

Third, the use of casts or other immobilization devices was reported by several respondents. This is a common practice in the management of plantar fasciitis, as the increased stress on the plantar fascia is believed to contribute to the pain.

Finally, we found that corticosteroid injections are often used in conjunction with other treatments, such as night splints or orthoses. This suggests a multimodal approach to the management of heel pain, where different treatments are combined to achieve the best outcome.

Overall, our findings highlight the complexity of the problem and the variety of approaches used by practitioners. Future research should focus on refining these treatments and understanding the optimal management strategies for heel pain.
cal, and environmental factors compose the foundation of most etiologic theories (Table 3).17

**Anatomical Factors.** The plantar fascia originates from the calcaneus and inserts into the volar plates of the proximal phalanges. It supports the arch and helps maintain plantarflexion of the toes.14 Inflammation or degeneration of the plantar fascia produces the symptoms of plantar heel pain syndrome.

Many clinicians subscribe to the theory that plantar heel pain syndrome is caused by acute and chronic inflammation of the plantar fascia. If inflammation is the etiologic factor, then the classic clinical signs of pain, heat, redness, swelling, and loss of function and histologic evidence of leukocyte accumulation should be present in the acute phase of plantar heel pain syndrome. In chronic “fasciitis,” histologic examination should reveal infiltration with macrophages, lymphocytes, and plasma cells as well as tissue destruction and evidence of repair.18

Lemont et al,18 however, believe that plantar heel pain syndrome is a degenerative process without inflammation and that *fasciosis* is a more correct term than *fasciitis* for plantar heel pain syndrome. He and his colleagues at Temple University School of Podiatric Medicine reviewed histologic findings from 50 cases of heel spur specimens submitted for pathologic analysis. They documented “myxoid degeneration with fragmentation and degeneration of the plantar fascia and bone marrow vascular ectasia” in these specimens, with no histologic evidence of inflammation.

**Biomechanical Factors.** Biomechanical factors that result in excessive traction forces on the calcaneus are frequently cited as the primary cause of plantar heel pain syndrome (Table 4).6 Researchers from the University of Kentucky proposed the windlass mechanism as a mechanical model to explain the biomechanical factors and stresses that cause plantar heel pain syndrome. Hallux dorsiflexion shortens the plantar fascia just as a windlass tightens a rope or cable. Pronation and supination create forces that increase plantar fascia tension. Imbalance between pronation and supination increases inefficient foot function and potential dysfunction. Excessive traction forces applied to the calcaneus irritate the plantar fascia and the medial calcaneal tubercle. These factors cause excessive strain (ie, increased tension) on the plantar fascia.6

Traumatic heel pain commonly derives from calca-

### Table 3. Heel Pain Etiology

<table>
<thead>
<tr>
<th>Source of Heel Pain</th>
<th>Characteristic Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mechanical</strong></td>
<td><strong>Posterior heel pain</strong></td>
</tr>
<tr>
<td>Plantar fasciitis</td>
<td>Pain worse in morning (plantar fasciitis)</td>
</tr>
<tr>
<td>Achilles tendinitis</td>
<td>Retrotibial calcaneal swelling and erythema (bursitis)</td>
</tr>
<tr>
<td>Haglund’s deformity</td>
<td>Risk factors: obesity, inappropriate footwear, pes planus, specific activities</td>
</tr>
<tr>
<td><strong>Traumatic</strong></td>
<td>Calcaneal injuries</td>
</tr>
<tr>
<td>Stress fractures</td>
<td>History of falls from heights or repetitive pounding activities</td>
</tr>
<tr>
<td>Plantar fascia rupture</td>
<td></td>
</tr>
<tr>
<td><strong>Neurologic</strong></td>
<td>Posterior tibial nerve</td>
</tr>
<tr>
<td>Medial calcaneal nerve</td>
<td>Burning pain, worse at night</td>
</tr>
<tr>
<td>Medial plantar nerve</td>
<td>Obesity, venous insufficiency often present</td>
</tr>
<tr>
<td>Lateral plantar nerve</td>
<td>Radiculopathy must be considered</td>
</tr>
<tr>
<td>Sural nerve</td>
<td></td>
</tr>
<tr>
<td><strong>Arthritic</strong></td>
<td>Rheumatoid arthritis</td>
</tr>
<tr>
<td>Gout</td>
<td></td>
</tr>
<tr>
<td>HLA-B27 seronegative spondyloarthropathies</td>
<td>(psoriatic arthritis, colitis, Reiter’s syndrome)</td>
</tr>
<tr>
<td>Other</td>
<td>Infections, tumors, aneurysmal bone cyst</td>
</tr>
<tr>
<td>Apophysitis in adolescents</td>
<td></td>
</tr>
</tbody>
</table>

Source: Data from Ref. 17.
neal injury. Falls from heights can cause intra-articular fractures, repetitive activities can create calcaneal stress fractures, and soft-tissue trauma can rupture the plantar fascia. Diagnosis often is based on clinical findings alone (eg, patient reports of a popping sensation in the proximal plantar heel region during activity, plantar ecchymosis, and inability to perform single-stance heel raise). Imaging studies (eg, plain films, magnetic resonance images, and technetium bone scans) may be ordered to confirm suspected sources of traumatic heel pain.

**Neurologic Factors.** Heel pain caused by neurologic factors is notably different because it is almost always unilateral. A patient with unilateral heel pain is likely to have entrapment or irritation of one or more of the nerves that innervate the heel (eg, posterior tibial, medial calcaneal, medial plantar, lateral plantar, and sural). Obese patients and those with a history of venous insufficiency are particularly prone to this type of plantar heel pain syndrome. Radiculopathy should be suspected if the pain radiates down the leg to the heel. Nerve conduction studies, electromyography, and magnetic resonance imaging may be indicated to identify the exact source of pain.

**Arthritic Factors.** The presence of bilateral plantar heel pain should make the clinician suspect a generalized systemic disease (eg, rheumatoid spondylitis, rheumatoid arthritis, systemic lupus erythematosus, and gouty arthritis). One author reported that of 116 patients with plantar heel pain syndrome, 16.4% had systemic disease. This same author reminds colleagues that the foot is second only to the knee (and outranks the hand) as the initial area of joint involvement in rheumatoid arthritis.

Musculoskeletal symptoms also should raise the question of possible inflammatory bowel disease. Arthritis associated with ulcerative colitis is one of the seronegative arthropathies (along with psoriatic arthritis) associated with HLA-B27. Thirty percent of patients with inflammatory bowel disease may present with peripheral arthritis, inflammatory spinal pain, dactylitis, enthesitis (Achilles tendinitis and plantar fasciitis), buttock pain, and anterior chest wall pain. In most cases, the intestinal symptoms coincide with or precede the onset of articular problems. Reiter’s syndrome is another HLA-B27–associated arthropathy and should be suspected in young male patients with calcaneal pain and a history of relapsing urethritis, conjunctivitis, and arthritis.

**Other Causes.** Less common causes of heel pain include calcaneal osteomyelitis caused by tuberculosis or *Pseudomonas aeruginosa*. Tumors and aneurysmal bone cysts are rare but still must be considered. In young growing children, apophysitis is the most common cause of heel pain.

### Importance of Early Treatment

The American Academy of Podiatric Sports Medicine sponsors public-service announcements and information available through the Internet to help prevent the development of heel pain. These educational materials also outline simple treatments for early-stage heel pain and caution consumers not to delay seeking professional treatment for persistent heel pain. Early treatment is important because the longer the duration of pain, the longer the time to final resolution.

### Conclusion

Podiatric physicians provide interventions at all stages of plantar heel pain syndrome. According to this survey, early management tends to consist of simple biomechanical interventions, such as calf muscle stretching, use of over-the-counter inserts and heel cushions, discouraging the wearing of flat shoes and walking barefoot, and strapping the foot. In addition, cryotherapy is frequently applied to the affected part.

When simple measures fail to relieve heel pain, prescription-strength nonsteroidal anti-inflammatory drugs, specific foot- and ankle-strengthening exercises, custom orthotic devices, and corticosteroid injections are used to relieve plantar heel pain syndrome symptoms. Plantar fascia rupture is an uncommon complication of plantar heel pain syndrome treatment, and recovery is complete in most cases. Late-stage therapy for refractory patients may include surgical plantar fasciotomy, cast immobilization, and extracorporeal shockwave therapy. A staged approach...
should give excellent results in the treatment of plantar heel pain syndrome, as these respondents indicated.

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References