

Plantar Heel Pain

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Continuing Education Activity

Plantar heel pain is a common problem among adults. It can lead to severe pain which causes significant disability and impairment of activities of daily living. Plantar heel pain can be due to local causes such as plantar fasciitis, referred causes like S1 radiculopathy, or systemic illness like seronegative spondyloarthropathies (SpA). The most common causes of plantar heel pain are plantar fasciitis, heel fat pad atrophy, calcaneal stress fractures, or entrapment of the tibial nerve, medial calcaneal nerve, or the first branch of the lateral plantar nerve (Baxter's nerve). This activity reviews the causes of plantar heel pain, illustrates a practical approach to identifying its underlying cause and outlines evidence-based management strategies. This activity illustrates the role of the interprofessional team in recognition and management of plantar heel pain.

Objectives:

- Describe the presentation of plantar heel pain.
- Summarize the evaluation of plantar heel pain.
- Review the management strategies for plantar heel pain.
- Outline interprofessional team strategies to improve care coordination and communication to enhance outcomes for patients affected by plantar heel pain.

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Introduction

Plantar heel pain is a common problem among adults; it can lead to severe pain which causes significant disability and impairment of activities of daily living. Plantar heel pain can be due to local causes, for example, plantar fasciitis, referred causes like S1 radiculopathy, or systemic illness like seronegative spondyloarthropathies (SpA). The most common causes of plantar heel pain are plantar fasciitis, heel fat pad atrophy, calcaneal stress fractures, or entrapment of the tibial nerve, medial calcaneal nerve, or the first branch of the lateral plantar nerve (Baxter's nerve). History taking and physical examination, are important for correct diagnosis. Laboratory studies diagnose the systemic causes of the plantar heel pain. Plain radiographs and computed tomography can confirm the diagnosis of the stress fractures of the calcaneus and bone tumors. High-resolution ultrasound confirms the diagnosis of the plantar fasciitis, heel fat pad atrophy, and entrapment neuropathies. Electrophysiological studies are required to scrutinize neurogenic causes of plantar heel pain. Magnetic resonance imaging, like ultrasound, can diagnose soft tissue pathologies and may be better than ultrasound for investigating bony disorders. Treatments include lifestyle modification, non-steroidal anti-inflammatory drugs (NSAIDs), rehabilitation, local injection, and surgery.[1][2][3]

Etiology

Local Causes

- Plantar fasciitis
- Plantar heel fat pad atrophy
- Calcaneal stress fractures
- Neurogenic causes, such as entrapment of the tibial nerve (posterior tarsal tunnel syndrome), medial calcaneal nerve, and Baxter's nerve
- Tumors, osteomyelitis, and plantar warts

Referred Causes

- S1 radiculopathy

Systemic Causes

- Rheumatoid arthritis (RA)
- Seronegative spondyloarthropathies (SpA)

Risk Factors

- Obesity
- Prolonged standing
- Inappropriate footwear

Epidemiology

Each year in the United States, people visit the physician more than 1 million times per year because of plantar heel pain. It involves athletes and sedentary people and affects both males and females equally. The most frequent cause of the plantar heel pain is the plantar fasciitis affecting approximately 2 million Americans each year. It affects almost 10% of the population over a lifetime. Calcaneal stress fractures account for 20% of lower extremity stress fractures in 109,296 soldiers, reported from a 4-year study conducted by Pester et al. Around 16% of patients with heel pain have a systemic illness like rheumatoid arthritis (RA). To the author's knowledge, the estimated prevalence of neurogenic causes of plantar heel pain is not clear.

Pathophysiology

Plantar Fasciitis

The plantar fascia includes medial, central, and lateral portions. The most important is the central portion which attaches proximally to the medial tuberosity of the calcaneus. It supports the longitudinal arch, and it elongates with rising mechanical loading. Obesity, prolonged standing, flat feet, soleus-gastrocnemius complex dysfunction and ankle instability can lead to excessive stress on the fascia. Aging leads to a reduction of the elasticity of the plantar fascia. All the above-mentioned factors will lead to degeneration of the plantar fascia rather than inflammation and thickening of the fascia.

Heel Fat Pad Atrophy

The heel pad is composed of closely packed fat chambers surrounded by tough circular or cone-shaped collagenous septa and elastin fibers. Reduction of fat chambers is due to micro-trauma and repeated corticosteroid injections, leading to a decrease in the shock absorbing properties and development of pain.

Calcaneal Stress Fractures

Normal weight-bearing stress is less than the threshold needed to cause a calcaneal fracture. Abnormal mechanical stress results in inadequate bone healing, osteoclast activation and thus stress fracture. Other relevant factors include: starting a new activity (running) and increased intensity or duration of previous activities (prolonged running and standing), obesity, inappropriate footwear, flat feet, and RA.

Entrapment Neuropathies

Tarsal tunnel syndrome is due to the entrapment of the tibial nerve underneath the flexor retinaculum on the medial side of the ankle. It might be idiopathic or secondary to diabetes mellitus, RA, and ganglion cysts.

Medial calcaneal nerve commonly arises from the tibial nerve above the level of the flexor retinaculum of the ankle. It carries sensory information from skin over the plantar surface of the calcaneus and subcutaneous fat. Its entrapment might be due to tight fascia, varicosities or scars of previous surgical procedures.

Baxter's nerve is the first branch of the lateral plantar nerve. It provides motor innervation to the quadratus plantae, flexor digitorum brevis, and abductor digiti minimi muscles. Also, Baxter's nerve carries sensory information from the calcaneal periosteum and the long plantar ligament. Baxter's nerve can be entrapped distally due to tight fascial planes between the abductor hallucis muscle and the quadratus plantae. Another entrapment site is at the anterior aspect of the medial calcaneal tuberosity (as it passes laterally) between the flexor digitorum brevis and quadratus plantae.

History and Physical

Plantar Fasciitis

Patients typically complain of heel pain accompanying the first steps in the morning after getting up. Others report heel pain after standing from a prolonged sitting position. In long-standing cases; pain might persist throughout walking and rest times. Tenderness usually elicited inferiorly over the medial calcaneal tubercle.

Heel Fat Pad Atrophy

Patients present with diffuse central plantar heel pain precipitated by barefoot walking on the hard surfaces. Tenderness can be elicited on the central part of the calcaneus.

Calcaneal Stress Fractures

Patients present with diffuse heel pain and positive squeeze test (tenderness on medial and lateral compression of the calcaneus).

Tarsal Tunnel Syndrome

Patients present with pain, tingling and hypoesthesia along the whole plantar surface. Tapping on the area behind the medial malleolus provokes a positive Tinel's sign.

Medial Calcaneal Neuropathy

Patients will present with burning pain and paresthesia on the skin over the calcaneus. Pain does not radiate distally as in cases of the entrapment of the tibial nerve or Baxter's nerve. Tinel's sign might be positive over the medial surface of the calcaneal bone.

Baxter Nerve Neuropathy

Patients have a sharp, radiating pain along the course of Baxter's nerve. Pain is worse after activities (e.g., walking) and at night. A positive Tinel's sign and maximal tenderness can be elicited at the above-mentioned two points of nerve entrapment.

S1 Radiculopathy

Patients might have a history of chronic low back pain. Clinically, radicular pain and numbness from back down to the heel. A positive straight leg raises test, a crossed straight leg rises test, or a Lasegue test can provoke it. The examiner might find a decreased sensation over the skin of the sole, heel and lateral foot. The physical examination might reveal the weakness of the gastrocnemius, gluteus maximus, hamstring, peroneal and foot muscles and diminished ankle reflex.

Systemic Causes

Symmetric or asymmetric polyarthritis, uveitis, psoriasis, lower gastrointestinal symptoms, enthesitis, balanitis, dactylitis, sacroiliitis, and spondylitis should be screened.

Evaluation

Most heel pain causes can be diagnosed clinically.[4][5][6][7]

Laboratory

The laboratory tests include acute phase reactants, Rheumatoid factor, Anti-Cyclic Citrullinated Peptide Antibodies, HLA-B27 For systemic causes of the plantar heel pain.

Plain Radiographs and Computed Tomography

Clinicians can order them to diagnose stress fractures and plantar calcaneal spurs.

Musculoskeletal Ultrasound

In patients with plantar fasciitis, the investigators may find thickening of the plantar fascia (greater than 4 mm) on the medial tuberosity of the calcaneus. An increase in vascularity under power Doppler ultrasound is not a common finding in plantar fasciitis.

Physicians can diagnose heel fat pad atrophy when they find the heel fat pad is thinner than 12 to 14 mm in non-weight bearing conditions.

The cross-sectional area of tibial nerve at the tarsal tunnel greater than 9.26 mm² or side-to-side difference greater than 0.8 to 1.76 mm² is diagnostic for the tarsal tunnel syndrome.

The Medial calcaneal and Baxter's nerves are small nerves. Their size was around 3 mm and 2 mm, respectively. To confirm the diagnosis of the entrapment of the medial calcaneal and Baxter's nerves, clinicians should compare the symptomatic side with the asymptomatic one and or perform ultrasound-guided diagnostic blocks.

In cases of Baxter nerve entrapment, ultrasound can show changes in the muscles (quadratus plantae, flexor digitorum brevis, and abductor digiti minimi) supplied by the nerve distal to the site of entrapment.

Regarding SpA, ultrasound can detect sub-entheseal erosions, enthesitis, and enthesophytes at the attachment of the plantar fascia to the calcaneus.

Electrophysiologic Studies

It is helpful in the diagnosis of tarsal tunnel syndrome, entrapment of the medial calcaneal nerve, diabetic polyneuropathy, and S1 radiculopathy.

Magnetic Resonance Imaging

A useful imaging modality to diagnose plantar fasciitis, entrapment of the tibial nerve at the posterior tarsal tunnel, bone cysts, stress fractures, tumors, among others.

Treatment / Management

Plantar Fasciitis

Treatment is usually conservative, including weight reduction, shoe modification, stretching, and NSAIDs. Nonresponders can benefit from shockwave therapy, ultrasound-guided corticosteroid injection or autologous blood-derived products (platelet rich plasma).

Hsiao et al. concluded that autologous blood-derived products, followed by corticosteroids, were best in providing relief from pain at three months. Shockwave therapy and autologous blood-derived products had a similar effect of pain relief at six months and were better than corticosteroids at that time.

As regards the placement of the injection, particularly corticosteroids above or below the plantar fascia, Gurcay et al. found that injection of corticosteroid deep to the fascia might cause a greater reduction in plantar fascia thickness, pain, and disability and improved foot-related quality of life. Recalcitrant cases will need surgery.[8][9]

Heel Fat Pad Atrophy

Rest, ice, NSAIDs, heel cups, proper footwear, and taping might be used successfully for reduction of pain and improvement of foot related activities of daily living.

Calcaneal Stress Fractures

Treatment aims to provide a satisfactory environment for healing and prevention of progression of the fracture, and subsequently, pain relief and improvement of activities of daily living ensue.

Treatment options include bed rest, four-point weight bearing with crutches and a 0.5-inch sponge rubber insert in the shoes. Also, NSAIDs, calcium, vitamin D and calcitonin injections can be useful. Pulsed magnetic field therapy helps pain reduction and promotes healing. Treatments for underlying systemic illness are mandatory.

Entrapment Neuropathies

NSAIDs and anticonvulsants can help reduction of symptoms. Non- responders can benefit from ultrasound-guided corticosteroid injection, hydrodissection using dextrose 5%, radiofrequency or cryoablation. Recalcitrant cases or severe cases might need surgical decompression.

Differential Diagnosis

- Achilles tendon injuries
- Distal plantar fasciitis
- Haglund syndrome
- Plantar fibromatosis
- Tarsal tunnel syndrome

Pearls and Other Issues

- The plantar calcaneal spurs are not a common cause of the plantar heel pain. Spurs are present in 50% of patients with plantar fasciitis. Over 15% of the general population has a radiologically asymptomatic spur.
- Repeated corticosteroid injection, for treatment of the plantar fasciitis, can lead to heel fat pad atrophy and rupture of the plantar fascia, due to attenuation of the fascia.

- Physicians should treat the underlying cause of the plantar fasciitis, such as flat feet and ankle instability; otherwise, symptoms will recur shortly after the injection under ultrasound guidance.

General ultrasound criteria for entrapment neuropathies include:

1. The cross-sectional area is more than 2 standard deviations above the mean reference value.
2. Change in the echotexture of the affected nerve, like being hypoechoic.
3. Notching and flattening of the nerve at the entrapment site.
4. Change in the fascicle size (enlargement of fascicles within the affected nerve).

Enhancing Healthcare Team Outcomes

The evidence supports none of the commonly available treatments over another for managing the plantar heel pain. However, local injection of corticosteroids, alone or in combination with exercise therapy, and extracorporeal shock wave therapy have the higher effectiveness in relieving plantar heel pain and improving function compared with other treatments in the short term, medium term and long term. [Level I]

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Figure

Plantar Heel Pain- note the large plantar calcaneal spur, commonly seen with plantar fasciitis and bursitis. In an older patient with plantar heel fat pad atrophy, the spur itself can be very prominent and painful. Contributed by Mark A. Dreyer, DPM, ([more...](#))

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