A Review of the Evaluation and Treatment of Heel Pain, Part 2

A panel of specialists review various diagnoses for heel pain in follow-up to last month’s overview of heel pain assessment.

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About 10 percent of the population will be affected by heel pain in their lifetime,¹ and non-treatment or delayed treatment may cause severe and debilitating discomfort or dysfunction. Appropriate assessment, as discussed in Part 1, is essential to proper care. Ahead, we review the various potential diagnoses for heel pain and their management.²⁻²⁶

HEEL PAIN DIAGNOSIS

Achilles Tendinopathy

Clinical suspicion for Achilles tendinopathy starts with pain localized over the Achilles tendon that is more pronounced with exercise. The pain is usually worse at the beginning and end of exercise.²⁷ Patients also report impaired performance and limited ability to participate in sporting activities. In severe cases it can affect activities of daily living, including constant pain during light walking. In the acute phase the tendon is diffusely swollen with tenderness to palpation most severe 2-6cm proximal to the tendon insertion, in some cases crepitation can be felt due to fibrin precipitation.²⁸

In chronic cases edematous swelling and crepitation is no longer present, but painful exercise remains. Also, tender nodular swelling may be present.²⁹ The diagnosis of Achilles tendinopathy is primarily made through history and physical exam, but imaging can be useful to confirm clinical suspicion or exclude other disorders. Ultrasound can be used for acute or chronic cases. In acute cases it shows fluid accumulation around the tendon. In chronic cases, a thickened irregular hypoechoic signal around the tendon is a sign of peritendinous adhesions.²⁸ MRI can also be used, which provides more detailed information about the anatomy of the tendon and its surrounding structures. When comparing the two imaging modalities, they both have similar specificities with MRI having a higher sensitivity.²⁹

Plantar Fasciitis

Diagnosis of Plantar Fasciitis can be made relatively good confidence with a thorough history and physical exam. Patients typically complain of gradually worsening pain at the inferior heel near were the plantar fascia attaches. Typical pain is described as throbbing, searing, or piercing and is usually worse with their first few steps in the morning or after a period of inactivity.³⁰,³¹

Pain tends to lessen with increased activity, but then worsens towards the end of the day as their time spent weight-bearing increases. Walking barefoot, on toes, or up stairs can aggravate the pain.³¹ They also may report limping while trying to keep their heel off of the ground. Risk factors that predispose patients include sudden increase in amount or intensity of running or walking, changed footwear, or exercising on a different surface. As well as, pes planus, decreased ankle dorsiflexion, obesity, or heel spurs.³⁰,³¹

Patients usually report a maximal area of tenderness localized over the medial calcaneal tuberosity at the plantar aponeurosis. Diagnostic imaging, such as ultrasound or
Tarsal Tunnel syndrome

Tarsal tunnel syndrome is caused by damage to the posterior tibial nerve where it travels under the flexor retinaculum on the medial side of the ankle, just posterior to the medial malleolus. It is relatively uncommon and if suspected other disorders in the differential should be considered and ruled out, such as; Polynuropathy, L5 and S1 nerve root syndromes, Morton’s metatarsalgia, compartment syndrome of the deep flexor compartment, Calcaneal spur, arthrosis, inflammatory changes of the fascia and ligaments, and ischemia.

The initial and most defining characteristics of tarsal tunnel syndrome are paresthesias or burning sensation at the medial plantar aspect of the foot. Walking or standing for long periods of time exacerbate the symptoms. Painful dysesthesias at night can affect patient’s ability to sleep. Painful pressure on the medial side of the ankle is a common complaint, which can intensify the paresthesias. Physical exam can elicit symptoms with forced eversion and dorsiflexion of the foot; a positive Tinel’s sign can also be bring out symptoms. As damage to the nerve increases neurologic deficits may be detected. Sensory loss located over the affected nerves is typically seen first, motor weakness occurs later in the course. Weakness appears first in the toe abductors and toe flexors. Changes such as muscle atrophy and decreased sweating are later occurrences. Common causes of tarsal tunnel syndrome are thought to be due to history of trauma, for example, fractures or ankle sprains. As well as, arthrosis, tenosynovitis, surgical procedures causing local swelling, muscle entrapment due to muscle hypertrophy, and rheumatoid arthritis.

Tarsal tunnel syndrome can be confirmed with the use of nerve conduction studies. The most sensitive study is to measure the sensory conduction velocity of the medial and lateral plantar nerves. Findings should show a significant difference in nerve conduction velocity and greater than 50 percent drop in amplitude between the two sides. Motor nerve conduction velocity of abductor hallucis brevis can also be performed, but is less sensitive. Positive findings are prolonged distal motor latencies and low amplitude of motor potentials and should be compared with the patient’s other side. Evidence of axonal injury on EMG can help confirm diagnosis, but again it must be compared with the other side of the body.

Ankle Sprain

Ankle sprains are typically acute injuries in the sporting population. They most commonly occur over the lateral ankle due to an inverted plantar flexed foot. The ligaments involved are the anterior talofibular ligament, the calcaneofibular ligament, and the posterior talofibular ligament. With ligament damage occurring most commonly to the anterior talofibular ligament followed by the calcaneofibular ligament. Typically patients present with significant ankle swelling, inability to continue their normal activities, pain on walking, and pain on palpation of the anterior talofibular ligament. A positive anterior drawer test has a fairly high sensitivity and specificity, but a combination of pain on palpation at the site of the anterior talofibular lesion, lateral discoloration due to hematoma, and a positive anterior drawer test had a 95 percent incidence of ligament lesion. In patients when the anterior drawer is negative and there is no ankle discoloration an ankle sprain is unlikely. A patient who presents with a painful ankle should be examined according to the Ottawa Ankle Rules to rule out a fracture and based on the rules clinicians can determine whether or not ankle radiographs are necessary to diagnose fracture. Or if there are continued symptoms imaging may be necessary.

Ankle/Foot Fracture, Stress Fracture

Calcaneal stress fracture is the second most common fracture in the foot, secondary to metatarsal stress fracture. Patients complain of pain in the posterior heel during an increase of weight-bearing activity, the pain occurs at first during increased activity and over time will present at rest. Also, changes to a harder walking surface can exacerbate the pain. Physical exam can show edema or ecchymosis over the calcaneus, as well as point tenderness to palpation. X-ray is not sensitive to stress fractures and if negative an MRI or bone scan may be necessary to confirm the diagnosis. Both imaging techniques have a high sensitivity, with MRI having a higher specificity. The most common site of fracture seen on imaging is inferior and posterior to the posterior facet of the subtalar joint, but can also be seen in the anterior and middle calcaneus with lesser incidence. Calcaneal stress injuries have been shown to be associated with other stress injuries of the foot and ankle, such as the cuboid and talus. Therefore, if a calcaneal stress fracture is diagnosed...
one should be vigilant to suspect a fracture of other tarsal bones.\textsuperscript{37}

Talar stress fractures are also fairly common and depending on location of fracture present with pain and tenderness at different locations. The majority of Talus stress fractures are due to inversion injuries and can be confused with an acute ankle sprain.\textsuperscript{38} Common areas of fracture and exam findings are: 1) lateral talar dome, with tenderness anterior to the lateral malleolus, along the anterior border of the talus. 2) Medial talar dome with tenderness posterior to the medial malleolus, along the posterior border of the talus. 3) Lateral talar process having point tenderness over the lateral process, which is anterior and inferior to the lateral malleolus. 4) Posterior talar process presents with tenderness to deep palpation anterior to the Achilles tendon over the posterior lateral talus for a lateral tubercle fracture or between the medial malleolus and Achilles tendon for a medial tubercle fracture.\textsuperscript{36,37}

It is important when diagnosing to use the Ottawa ankle rules in order to determine if the injury requires radiography, but to also consider the fact that the Ottawa ankle rules rarely took into account talar stress fractures. Even so the patients inability to weight-bear on that extremity due to fracture should lead the examiner to obtain imaging.\textsuperscript{38} Like calcaneal fractures MRI is more sensitive and specific over x-ray and more specific than bone scans. Also, It was secondary fractures within the foot were commonly seen with tarsal stress fractures and should be considered when a tarsal fracture is diagnosed.\textsuperscript{39}

**Heel Spur**

The belief that heel spurs are a cause of heel pain is quite controversial due to the high percentage of heel spurs in the population whom do not have heel pain. It has been thought that heel pain was not only due to heel spurs but other factors such as underlying plantar fasciitis, but recent research has shown a strong correlation between heel spurs and heel pain.\textsuperscript{40} Clinically they have similar presentations such as pain in the morning upon standing and first steps that is sharp and knife like, but improves throughout the day. It is believed that the pain is not from the spur itself, but the damage it does to the surrounding soft tissues.

Ultrasound and x-rays can both be helpful in diagnosing of heel spurs. X-rays can provide information about heel spur location and length; it is believed that heel pain is related to an increased length of the heel spur. Ultrasound can also assess the length of the heel spur, but can also evaluate any fat pad abnormalities, which has been correlated with heel pain.\textsuperscript{39,40}

**CONSERVATIVE TREATMENTS FOR HEEL PAIN**

Conservative treatment of heel pain begins with a broad-based approach, the initial steps of which include identifying, suppressing and modifying any possible predisposing factors. Temporary suspension of sports activities and treatment with anti-inflammatory medications along with physiotherapy are recommended.\textsuperscript{41} NSAIDS may be prescribed for an initial short course of two to three weeks to treat heel pain. According to a randomized study by Donley et al., the use of NSAIDs has been shown to decrease disability and increase pain relief.\textsuperscript{42} Other modalities such as ice and massage in conjunction with NSAIDs have also been found to help alleviate heel pain.

As risk factors of heel pain may include weakness of the intrinsic foot muscles and tightness of the gastrocnemius and soleus muscles, stretching and strengthening programs with physical therapy are also recommended as treatment. A study by Wolgin et al. noted 83 percent of patients involved in stretching programs were successfully treated for heel and foot pain.\textsuperscript{43} And 29 percent of those patients reported that stretching was more effective in reducing heel pain than the use of NSAIDs, ice, or splints. In physical therapy, patients are instructed to stretch the plantar and calf-plantar fascia by using the wall or stairs. A dynamic stretching technique such as rolling the arch of the foot over a tennis ball is also effective. Other exercises to consider are toe curls, foot-ankle circles and heel-raises with toe dorsiflexion.

Patients with pes planus or flat feet are predisposed to plantar fasciitis, which often results in heel pain. Arch-supporting athletic shoes and shoe inserts are advised to help treat heel pain associated with pes planus. For this same reason, walking on bare feet or on thin slippers should be avoided. Supportive shoes and sandals should be placed near the bed to help alleviate and prevent pain that often occurs with the first step out of bed in patients with plantar fasciitis. Other approaches for patients with low arches are supportive taping, heel cups, night splints and orthotics.

Low-Dye taping only provides transient support but is the most frequently used style of supportive taping as it is often the most cost effective in the acute setting. The purpose of low dye taping is to off-load the plantar fascia to decrease heel pain. Researchers have found statistically significant benefits of low dye taping in “first-step” pain compared to that of sham ultrasound.\textsuperscript{44}

Heel cups are designed to decrease the tension on the plantar fascia and decrease the impact on the calcaneus. Multiple studies show heel cups effectively decreased heel pain in patients with Sever’s disease, however in patients with plantar fasciitis, reports have not been quite as positive as heel cups were ranked the least effective of 11 different treatments.\textsuperscript{45,46}

Night splints are used to maintain a neutral position of the ankle to allow for passive stretching of the calf and plantar fascia during sleep. The purpose of this design is to cre-
ate less tension with that “first step in the morning.” Night
splits have been shown to be particularly helpful in individu-
als who experienced greater than 12 months of heel pain
from plantar fascitis. Some of the reported disadvantages
of night splits include interference with sleep and some
degree of discomfort.

Orthotics are also used to treat heel pain, as it is primarily
designed to promote proper biomechanical alignment of
the foot to achieve maximum comfort. An important char-
acteristic for successful treatment of heel pain while using
orthotics is to control over pronation and metatarsal head
motion. The effectiveness of it remains controversial how-
ever, as is the high price range that often discourages the use
of orthotics as the first choice of treatment.

INJECTION THERAPY FOR HEEL PAIN

There are various types of injections used to treat heel pain
that is refractory to conservative. These include corticosteroid
injections, dry needling, protein rich plasma, and mesenchymal
stem cell injections.

Corticosteroid injections have been used for a long time
as the next step in heel pain management after conservative
treatment. There is no gold standard for the type or dosing
of corticosteroid, and the steroid may be combined with an
anesthetic, such as lidocaine, to provide more instantaneous
relief. Injections can be performed under ultrasound guidance,
where injured plantar fascia have a thickened and hypoechoic
appearance.

Most studies have shown pain relief in the short term,
but no significant long lasting relief from corticosteroid
injections. Crawford et al demonstrated a statistically sig-
nificant reduction of pain at one month when comparing
prednisolone to lignocaine injections. However, there was
no significant difference at three and six months. In another
study comparing dexamethasone to saline, Schulhofer found
a more significant improvement of symptoms in the steroid
group at four weeks, but not at eight and 12 weeks. Of note,
there was a reduction of plantar fascia thickness observed
under ultrasound imaging at each investigated time.

Nonetheless, a recent randomized control study has shown
a lasting effect of corticosteroid injections. Ball et al compared
methylprednisolone to saline injections with and without ultra-
sound guidance, finding a statistically significant improvement
in pain at both six and 12 weeks. This is the first study to have such
results, and further trials would be necessary to support this evi-
dence. Additionally, there was no difference in symptoms with
ultrasound guidance, suggesting that the effect of the steroid
results from diffusion and that precise injection of the steroid is
not necessary.

Corticosteroid injections come with risks, though
uncommon. These include plantar fascia rupture, fat
pad atrophy, lateral plantar nerve injury, and calcaneus
osteomyelitis. Acevedo, Beskin found 44 out of 51 cases of
plantar fascia rupture to be associated with corticosteroid
injection. Sellman looked at 37 cases of plantar fascial
rupture, all of which had prior corticosteroid injections.

More recently, dry needling has been used to provide
symptom relief. A needle is inserted into the myofascial trig-
er point in the heel and manipulated in various directions.
The most common muscles needled include the soleus, gas-
trocnemius, quadratus plantae, flexor digitorum brevis, and
abductor hallucis. Adverse effects have included bruising
and an initial exacerbation of symptoms. These side effects
are transient in nature. This procedure has not yet been
studied at length.

However, Matthew et al. compared dry needling to sham
needling, demonstrating a statistically significant reduction
in plantar heel pain at six and 12 weeks post-procedure. Kalaci et al. compared injections of autologous blood, lido-
caine with peppering, steroid, and steroid with peppering.
There was a superior effect in the steroid with peppering
group rather than the steroid alone group, suggesting that
the peppering, or needling, itself plays a significant role in
pain relief.

Injections are also being performed using platelet rich
plasma (PrP). A patient’s own blood sample is centrifuged to
concentrate one’s platelets. This platelet rich plasma is then
injected into the heel. The notion is that this plasma is full
of autologous growth factors that will stimulate healing in
damaged tissue. However, there is no standardization for the
process, leading to controversy in its use. Furthermore, there
are few controlled trials of PrP injections.

Ragab, Othman compared ultrasonographic evaluations
of the plantar fascia before and after PrP injection. Initially,
patients with plantar fasciitis had thickened plantar fascia
near the origin at the calcaneal tubercle. On follow up at
two weeks, six weeks, and three months, there was reduc-
tion of the plantar fascia thickness, reflecting healing.
Aksahin et al. compared the effects of steroid injections and
PrP injection. Their results showed statistically significant
improvement in pain in both groups at three weeks and
six months. However, there was no significance between
the two groups. Another prospective randomized study by
Monte revealed significant improvement in pain for PrP
injections over corticosteroid injections at three, six, 12,
and 24 months. No side effects have been demonstrated
in these studies. Mesenchymal stem cells are also being util-
ized in a similar fashion as PrP. These cells are derived from
adipose or bone marrow aspiration and treated in a similar
centrifuge fashion as blood for PrP. The research and data
collection is ongoing for this technique and its uses and out-
comes are yet to be determined.
Other injections, such as hyperosmolar dextrose (prolotherapy), whole blood, and onabotulinumtoxinA (Botox) are also being investigated for treatment of heel pain, but they are beyond the scope of this review.

**SURGICAL TREATMENT OPTIONS FOR HEEL PAIN**

While heel pain encompasses a diverse group of pathologies, it generally will respond well to conservative treatment irrespective of the etiology. Operative intervention is reserved only for recalcitrant cases that have not responded to non-operative treatments over a period of at least four to six months.

For posterior heel pain caused by insertional Achilles tendinosis, the goal of surgery is to address the diseased tendon, the inflamed retrocalcaneal bursa, and the calcaneal exostosis. While variations exist in operative technique, the procedure involves exposure of the tendon and posterior calcaneus, debridement of nonviable tissue and exuberant bone, and reattachment of the reflected Achilles tendon. In this procedure, up to 50 percent of the tendon may be resected with no risk for iatrogenic Achilles tendon rupture. Young, athletic patients may begin protected weight bearing immediately, while overweight and older patients may need several weeks of non-weight bearing. Patients begin physical therapy at three to four weeks and return to normal shoe gear at six weeks postoperative.

In the case of heel pain caused by recalcitrant plantar fasciopathy, the preferred operative interventions include endoscopic partial plantar fascia release, open partial plantar fascia release with release of the inferior calcaneal nerve, and gastrocnemius recession. Plantar fascia release entails release of the medial third of the central band of the plantar fascia. The rationale is that the stresses of the medial plantar fascia are highest, decreasing laterally. Partial release of the plantar fascia relieves these stresses and removes the cause of irritation. This may be performed open or endoscopically. The endoscopic approach requires less dissection and less exposure and is associated with faster recovery times and better postoperative function. The downside to the endoscopic approach is that the surgeon is unable to address impingement of the inferior calcaneal nerve, another possible etiology of heel pain. The postoperative protocol consists of weight bearing as tolerated with gradual transition to normal shoe gear with a protective orthosis to support the arch. Patients may resume full activity after three months.

The objective of gastrocnemius recession is to address tightness of the triceps surae. A well-established correlation exists between equinus deformity and plantar fasciopathy, and lengthening of the gastrocnemius has been demonstrated to be a viable procedure in the treatment of isolated heel pain. This is achieved by exposing the gastrocnemius and transecting it at the musculotendinous junction. Patients may bear weight as tolerated after the procedure with a gradual return to normal activity. A home exercise program to restore strength and range of motion is begun after two weeks. While a theoretical concern exists for loss of plantarflexion strength, one series of 126 cases with a mean follow up of 19 months reported no deformity or weakness among their complications.

For patients with impingement of the tibial nerve, whether as an isolated problem or coexisting with other heel pain syndromes, tarsal tunnel release can offer relief. This is achieved by exposing the flexor retinaculum and opening up the nerve sheath. If any space-occupying lesions are present, these are excised. If concomitant plantar fasciopathy is evident, this may be addressed at the same time. Occasionally, insufficiency of the plantar fascia and posterior tibial tendon results in a deformity placing traction on the tibial nerve. In this setting described as the “Heel Pain Triad,” not only is tarsal tunnel release indicated, but the surgeon must also consider reconstructive procedures to correct the posterior tibial tendon dysfunction.

**HEEL DISABILITY AND IMPAIRMENT**

Similar to other pain syndromes, acute and/or chronic plantar heel pain has a significant negative impact on quality of life and there are many contributing factors leading to disability due to heel pain. Chronicity of symptoms as well as age, decreased ROM, and increased BMI were found to play a significant role in predicting concurrent baseline disability.

In two retrospective cohort studies involving 432 patients, the mean duration of symptoms ranged from 13.3 to 14.1 months before diagnosed with chronic planter heel pain and seeking treatment. Interestingly, the kinesiophobia was the strongest single contributor to disability in a cohort study. Kinesiophobia is described as “an excessive, irrational, and debilitating fear of physical movement and activity resulting from a feeling of vulnerability to painful injury or re-injury.” The TSK-11, a shortened version of the Tampa Scale for Kinesiophobia, consists of an 11-item questionnaire scored on a 4-point scale, with a maximum score of 44-point that examines fear of re-injury and pain. Scores range from 11 to 44 points, 11 being the lowest levels of kinesiophobia. In the cohort study, the average TSK-11 score was 22.3 and contributed a 14 percent of the variance in disability scores. Demographics background contributed 9% (P=.015) of the variance in disability scores, where as pain intensity and overall ROM deficit contributed an additional 11% (P<.001) of the variance.

There are other functional measurements that clinicians can use to measure the outcome of patients with heel pain.
pain. The Foot Function Index (FFI), Foot Health Status Questionnaire (FHSQ), the Foot and Ankle Ability Measure (FAAM), have been well studied and used in many research studies. These self-administered questionnaire can be used before and after interventions to assess the impairments of body function, activity limitations, and participation restrictions associated with heel pain.

CONCLUSION

Heel pain is a complex diagnosis, and can be difficult to treat at times. Multiple specialties can see patients with heel pain, and may have different approaches to diagnosis and treatment. Conservative and interventional options are available for treatment. Proper treatment is often the result of proper diagnosis. Many times treatments are tailored for patients based on their diagnosis, and goals. Most often, conservative treatments result in success. However, the clinician should have a high index of suspicion for specific diagnosis when conservative management fails, this way the correct intervention may be used, and effective treatment is achieved sooner than later.

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