CONTINUING EDUCATION
for Physical Therapists

HEEL PAIN: LOOKING BEYOND PLANTAR FASCIITIS

1 CE HOUR

Course Abstract

This course encourages clinicians to look beyond plantar fasciitis in their evaluation and diagnosis of plantar heel pain, presenting differential diagnoses and examining evidence-based treatment options.

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Approvals

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Target Audience & Prerequisites

PT, PTA – no prerequisites

Learning Objectives

By the end of this course, learners will:

- ❑ Recognize components of foot and ankle anatomy
- ❑ Recall elements of foot and ankle evaluation
- ❑ Differentiate between causes of heel pain other than plantar fasciitis
- ❑ Identify evidence-based management techniques for heel pain

Timed Topic Outline

I. Plantar Fasciitis Overview (5 minutes)

II. Foot & Ankle Anatomy (5 minutes)

III. Evaluation (10 minutes)

IV. Differential Diagnosis (30 minutes)

Fat Pad Atrophy, Heel Pain Syndrome, Nerve Entrapment, Posterior Tibialis Tendonitis

V. Management (5 minutes)

VI. Conclusion, References, and Exam (5 minutes)

Delivery Method

Correspondence/internet self-study with a provider-graded multiple choice final exam. *To earn continuing education credit for this course, you must achieve a passing score of 80% on the final exam.*

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Course Author Bio and Disclosure

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Since 1997, he has been employed by Rehab Associates of Central VA, where he became a partner in 2002. He specializes in the foot and ankle, and treats a wide range of patients, including athletes, post-surgical, and degenerative conditions. Joe credits his approach to foot and ankle patients to his mentor Josh Bailey PT, DPT, OCS, CSCS, CPed.

DISCLOSURE: Financial – Joseph W. Spagnolo received a stipend as the author of this course. Nonfinancial – No relevant nonfinancial relationship exists.

I. INTRODUCTION

In the clinic, I see all types of foot and ankle patients, including athletes, post surgical, diabetic, and degenerative conditions. I am notorious for complaining to my colleagues about my biggest physical therapy pet peeve (yes, I know that everyone is on the edge of their seats to hear what it is):

The mis-diagnosis of plantar fasciitis.

While it is a fine, and in fact often a valid, diagnosis, "plantar fasciitis" is misused by patients and medical professionals alike as a catch-all diagnosis for any plantar heel pain. Amazingly, I have had patients point to the back of the heel or the dorsum of their foot and say that they were told by a medical professional that they must have "plantar fasciitis" – after all, their foot hurts upon initial weight bearing after sleeping, so what else could it be?

Literature states that "plantar fasciitis" affects over 1 million people annually, with 2/3 of those affected seeking medical assistance (4). That is a significant patient population to whom we owe the due diligence of critical thinking in regards to plantar heel pain. And while plantar fascial pathology is certainly a cause of plantar heel pain, there are other neural, skeletal, and soft tissue causes that must be considered to appropriately treat our patients.

This course will discuss common causes of plantar heel pain, examine what the evidence says in terms of treatment, and provide insights stemming from my own work treating plantar heel pain.

Let's begin with a brief review of plantar fasciitis specifically.

Per the literature, true plantar fasciitis involves microtears at the calcaneal enthesis (4). Typical presentation includes pain upon initial weight bearing after periods of non weight bearing – this is the calling card, if you will, of plantar fasciitis. There can be sharp pain at the medial calcaneal tubercle and pain can be elicited with passive extension of the first toe.

(Plantar fasciitis is typically chronic – so perhaps it should not be labeled

fasciitis at all, as by definition that refers to an active inflammation. If we are truly using appropriate nomenclature, "plantar fasciosis" would be more accurate.)

The plantar fascia is the most important passive stabilizer of the longitudinal arch. During gait, the plantar fascia provides protective tension when the hip and knee are in extension in combination with ankle dorsiflexion and toe extension: this is referred to as the "windlass mechanism." The presence of this function allows for normal foot mechanics, including the inversion of the heel during terminal stance which makes the foot stable for push off (9). If this fails, the foot is subjected to undue and abnormal stresses resulting in injury, functional deficits, and pain.

Risk factors for plantar fasciitis include excessive pronation, excessive running, pes cavus, obesity with a BMI greater than 30, prolonged standing and walking occupations, a sedentary lifestyle, and tightness in the Achilles tendon and intrinsic foot musculature. Interestingly enough, subcalcaneal spurs are not supported in the evidence as a risk factor or cause of plantar fasciitis: in fact, these horrific-looking spurs are often present in people who are asymptomatic. With that in mind, the next time a patient comes into your office asking if have a hammer to break off the spur in their heel, please quickly offer other less medieval treatment options.

NSAID use is supported in the literature to get temporary relief of heel pain, and extensive treatment options are also supported. Of course, because plantar fasciitis is an overuse injury, the age-old practice of rest and activity modification has value – we need to look at our patients in terms of their prior and current activity level as this may be a cause. Runners in particular are often victims, as they increase mileage too aggressively when training for a race: some running research recommends a 5-10% progression of running mileage to foster safety of the athlete (13). As mentioned previously and noted by Goff et al., overpronation is a risk factor for plantar fasciitis; custom and prefabricated foot orthotics are effective in correcting the issue. I use orthotics, in conjunction with appropriate shoes, to normalize abnormal mechanics and therefore decrease the strain to the plantar fascia. (When evaluating for custom or prefabricated foot orthotics, a biomechanical profile is needed.) Perhaps most widely represented is stretching of the plantar fascia and intrinsic musculature as well as the gastrocnemius and soleus : examples include a dorsiflexion towel stretch done prior to weight bearing, stair stretches, and hurdle stretching with the knee straight and bent. Personally, I feel that the simple towel stretch is very effective when done consistently, making sure the foot is slightly supinated to lock the midtarsal joints as much as possible and allow for appropriate stretching (4).

II. ANATOMY

I am often asked why I like to look at stinky feet all day. The answer is easy: our feet are the base of our physical structure. If the human body is an amazing house, with each part playing a specific role, the foot and ankle are the foundation. I am sure that you have heard the adage "when the foundation is cracked, the roof leaks;" as physical therapists, we can certainly appreciate this in terms of the foot and ankle! When they are inefficient, the rest of the body is adversely affected.

With that in mind, I will briefly review foot and ankle anatomy in regards to plantar fasciitis.

The plantar fascia is the fibrous connection of the heel to the metatarsal heads. There are actually three segments: the medial and lateral segments cover the abductor hallucis and abductor digiti minimi respectively, and the central portion is what is commonly referred to as the plantar fascia. This central portion originates from the medial calcaneal tubercle and inserts into the plantar plate, sesamoids, and all five metatarsal heads. In addition, the Achilles tendon may attach to the central portion. As the central portion extends to the metatarasal heads, it divides into 5 separate portions (3). Clearly, the plantar fascia is an extensive structure – which makes sense given the important responsibility that we assign to it with each step.

The calcaneus, the largest bone in the foot, is the main osseous structure when considering heel pain. In regards to the plantar or inferior aspect of the calcaneus, it is triangular in shape with the apex of the triangle anterior towards the forefoot. The base of the triangle has two tuberosities. The medial tuberosity, the larger of the two, is responsible for accepting the majority of weight bearing. The origin of the flexor digitorum brevis and the plantar fascia is located at the posterior tubercles. In addition, the abductor hallucis arises from the posterior medial calcaneal tubercle. The abductor digiti minimi arises from the posterior lateral tubercle with some attachment to the medial calcaneal tubercle. The ligamentum plantaris longus attaches posteriorly and the longitudinal plantar ligament and short plantar ligament attach anteriorly (9). In addition, like all bone, the calcaneus is covered with innervated periosteum.

The talus and the calcaneus form the subtalar joint, which is important for foot biomechanics in term of pronation and supination. This will be further discussed in the evaluation process.

Muscular attachments to the calcaneus were briefly mentioned above. Of particular interest when discussing heel pain, while certainly not an all-inclusive list, are the posterior tibialis, flexor hallucis longus, flexor digitorum, peroneus brevis, quadratus plantae, abductor hallucis, and abductor digiti minimi.

It is important to appreciate the anatomical features of these muscles to assist in differential diagnosis of heel and plantar foot pain. The posterior tibialis, flexor hallucis longus, and flexor digitorum run together medially in a sheath posterior to the medial malleolus towards the plantar aspect of the foot. The posterior tibialis inserts into the navicular tuberosity, all three cuneiforms, cuboid, and two-four metatarsals. At times, there is an insertion into the fifth metatarsal. The flexor hallucis longus inserts into the distal phalanx of the first toe, while the flexor digitorum longus attaches to the distal phalanx of the two through five. The flexor digitorum brevis originates from the medial calcaneal tubercle and plantar fascia to the middle phalanx. The quadratus plantae is attached to the posteriolateral calcaneal tubercle and inserts into the common flexor tendon (9). The abductor hallucis has attachments at the medial calcaneal tubercle to the great toe. The abductor digiti minimi courses from the lateral calcaneal tuberosity to the base of the proximal phalanx of the fifth toe. The peroneus longus courses plantarly around the cuboid to the lateral aspect of the first metatatarsal.

The calcaneal fat pad is like no other fat in the human body. Its unique structure is internal: chambers formed out of septa house the adipose tissue, forming a very efficient shock attenuation system (9). It is clear that significant force due to body weight goes through the heel with weight bearing. With fat pad atrophy or shearing, shock attenuation is less effectively addressed. This can cause pain in the heel or up the kinetic chain: remember, when the foundation is cracked, the roof leaks. While the average fat pad thickness is 18 mm (ranging from 12-22 mm), with age, or miles as I like to refer to it, the fat pad will typically deteriorate and thin. This is usually more prevalent in males than females. In addition, histologically, the fat pad tissue becomes more fragmented (9).

The tibial nerve as it courses into the heel is another important structure. At or above the medial malleolus, the tibial nerve divides into the medial and lateral calcaneal nerve. The medial calcaneal nerve derives off the medial plantar nerve to innervate the medial, posterior, and inferior heel. The first branch of the lateral plantar nerve runs inferomedial to the calcaneus to innervate the calcaneal periosteum, flexor digitorum brevis, and the abductor digitimini (3). In addition, as we all recognize, a neural impingement proximally can also affect heel pain.

The previous was a cursory review of relevant anatomical structures in the plantar aspect of the foot in the heel region. It is by no means exhaustive, although I am sure the reading through is less than exciting and can be classified as exhausting.

III. EVALUATION

Prior to discussing differential diagnosis of heel pain and discussing management, I will describe a typical evaluation that I utilize in my practice.

Screen

When a patient presents with foot or lower extremity problems, a quick biomechanical screen will determine if a further in depth foot and ankle evaluation is warranted. I check three actions in standing: a quarter squat, single and double heel rise, and pronation/supination.

A word of caution: with apologies for the horrendous pun, patients often try to put their best foot forward, altering their foot position in an effort to maximize their chances to "pass" the test. Prior to testing, I have them march in place three times while standing. When they stop marching in place, that is where their feet should stay for screen.

The first part of the screen is to have them unlock their knees with a quarter squat. The inferior pole of the patella should be on top of the second/third metatarsal. If the knee tracks medially or laterally, they fail the screen.

During the second part of the screen, the heel rise, when viewed posteriorly, the heel should clear the ground and invert.

The third part of the screen, the pronation/supination test, is done in quarter squat. The patient actively supinates and pronates their feet. The motions should be approximately equal.

If any aspect of the screen fails, a more in depth foot and ankle evaluation is warranted.

Evaluation

Of course, when evaluating the foot and ankle, every case is individualized; that said, here is the framework for a general approach.

The first component of the evaluation is the taking the history: as we all know, a good history will go a long way in pointing us in the right direction. What is the mechanism of injury? If the heel pain is gradual and insidious, it may suggest a fat pad issue; if it's acute and came on suddenly with a "pop" while chasing the grandkids, it's perhaps a plantar fascia rupture. Is there an underlying disease? For example, rheumatoid arthritis can affect the subtalar joint. Did the patient suddenly change their activity of rapidly progress their current activity level? I see many members of the running community in my area; often, runners will come in with foot injuries after progressing their mileage too quickly in preparation for the upcoming race.

I typically start the objective aspect of the evaluation with the patient standing.

I will assess resting calcaneal stance position to determine if the patient is in varus or valgus. I quantify this and compare to maximum pronation. Yes, that is right – we looked at that grossly during the foot screen. At this point, I will also measure the position of the calcaneus.

Likewise, tibial angle is assessed in standing: excessive tibial varum can be a significant biomechanical problem.

In this position, I can also grossly determine the axis of inclination of the subtalar joint: by comparing the motion of the talus to the calcaneus when performing supination and pronation, the inclination angle can determined. If the talus moves more than the calcaneus the inclination angle is high, calcaneus more than the talus denotes a low inclination angle, and if they are equal in movement the inclination is considered average. From this observation, you can determine an expected amount of subtalar mobility at varying inclination angles. With a high inclination axis 2-4 degrees of eversion is expected. Average axis will demonstrate 4-6 degrees, while a low axis will demonstrate 6-8 degrees of eversion. This information can be used to determine biomechanical deficits in terms of the amount of pronation that occurs through the subtalar joint.

The best way to measure the amount of pronation is to capture data in the frontal plane using a starting and ending position. Place the patient in subtalar neutral, as described below in prone, and measure the leg to rearfoot position for the "starting" position. This is compared to the "ending" position of maximum pronation with a measurement of the leg to rearfoot in standing with a quarter squat.

I know that sounds confusing, so let's go through an example.

If the measurement of the leg to rearfoot in prone is 6 degrees of inversion (calcaneal varus) - and while standing in maximumly pronated position is 10 degrees of eversion (calcaneal valgus) - the amount of motion in the frontal plane is 16 degrees.

With an "average" inclination angle of the subtalar joint is determined to be "average," you can expect 4-6 degrees of pronation, or eversion in the frontal plane, to occur.

So, at 16 degrees, this patient experiences 3-4 times more frontal plane motion than what is expected. This is a situation where the patient is a significant over-pronator, which can lead to deleterious physical effects.

A word of caution: if you see a patient with significant calcaneal valgus in standing, do not assume that he or she is an over-pronator. For example, that very patient may have a tarsal coalition and be, in fact, an under-pronator due to the coalition. You must do your due diligence and go through the measurement process.

I continue the evaluation with the patient prone.

In this position I will determine passive motion for inversion and eversion by measuring the calcaneus. Inversion and eversion occurs at the subtalar joint. Normal eversion is 10-20 degrees while inversion is 20-30 degrees. To assess this, it is easier to appreciate with the patient prone versus supine and measuring the dorsum of the foot.

In addition, I look at rear foot and fore foot position in subtalar neutral. In this position, the talus in the most congruency in the ankle mortise. Here you can identify varus or valgus orientation of the rear foot and fore foot. This helps to determine the osseous structure of the foot, which can drive management.

Subtalar joint neutral is also used to measure passive dorsiflexion. Normal passive dorsiflexion is 0-5 degrees. Restrictions can be caused by muscular tightness of the gastrocnemius, solues, and to a lesser extent plantaris. In addition, talocrural joint restriction can limit dorsiflexion, called "ankle equinus." Ankle equinus can have a significant deleterious effect on the foot and ankle due to compensations required to proceed through the gait cycle. If the needed dorsiflexion to progress from initial contact to toe off is not available, other structures compensate to achieve this. Often this is accomplished with hypermobility of the calcaneocuboid joint, unlocking the midfoot and causing unstable foot and less efficient lever for toe off. Another biomechanical deficit of ankle equinus is a lack of windlass mechanism (as mentioned previously). The windlass mechanism requires adequate ankle dorsiflexion and toe extension to allow for the plantar fascia to passively stabilize longitudinal arch needed to foster a rigid lever arm during terminal stance. Clearly, the amount of passive toe extension also needs to be appreciated.

I next look at the patient in supine.

In supine one of the most important areas to assess is leg length. Leg length discrepancy can be a source of discomfort, and also biomechanical faults in the foot and ankle as well as proximally at the lumbar spine and hip region.

Malleolar torsion is appreciated as well as first toe extension. Limitation in first toe extension, whether hallux limitus or hallux rigidus, will adversely affect mechanics during gait, similarly to ankle equinus, creating potential for injury.

The status of the longitudinal midtarsal joint (talonavicular) and oblique midtarsal joint

(calcaneocuboid) is assessed in supine. (Mobility at these joints should assessed with the foot in both supination and pronation. In a pronated position, the axes of the midtarsal joints are parallel to allow mobility of the midfoot and shock absorption. In supination, the axes are perpendicular making the midfoot rigid which is important during toe off in gait.)

Also, muscle testing of the intrinsics, ankle, and hip musculature is performed in supine. Hip strength is very important for foot and ankle function.

Selective tissue testing is an important part of the evaluation. Is the source contractile? Is it a nerve? If we are able to reproduce the symptoms for which the patient is in our office, we can glean information that is very useful to determining the problem.

IV. DIFFERENTIAL DIAGNOSIS

OK, so now we are at the point of trying to make sense of what the evaluation has told us.

We have already discussed the relevant anatomy of the foot and ankle for heel pain. Also, we have discussed plantar fasciitis. What other causes of heel pain are there, and how do we manage them?

Well, there are many other causes of heel pain – including but not limited to a calcaneal stress fracture, a bone tumor, and disease processes such as Paget's disease – but the most common are fat pad atrophy, heel pain syndrome, nerve entrapments, and posterior tibialis tendonitis.

Fat Pad Atrophy

Fat pad atrophy is very common. Recall that when we are young, the fat pad under the calcaneus is organized in septa to make columns of fat. The fat pad can later thin or in fact shear off the bottom of the calcaneus.

Typically patients will say that they feel there is a "rock in their shoe." The pain is worse with weight bearing activity, and tenderness to palpation is noted at the central heel. When the fat pad is sequestered and the area is palpated, the symptom is reduced (so suddenly that often patients accuse me of performing voodoo!).

Management

To manage fat pad atrophy, I will use a progression of techniques aimed at controlling the position of the fat pad.

Taping and a rigid heel cup are often effective.

When taping, the goal is once again to sequester the fat pad such that during weight bearing there is adequate protection for the calcaneus. The problem with this is anybody not named Stretch Armstrong will not be able to tape their own heels.

A rigid heel cup is much more user friendly; however, some coaching of the patient may be necessary. The heel cup that I am referring to is a rigid piece of plastic – and it often seems counterintuitive to a patient that they need to put something hard under a heel that already hurts. I find it helps to explain that the idea is to use a device that will actually cup the heel, and the soft pads available from the local Walmart are not effective in accomplishing this goal. Often, I need to use a custom foot orthotic to address this problem; this works equally well for individuals who have excessive or restricted pronation.

In patients with excessive pronation, there can be significant shearing of the plantar foot including the fat pad. Shearing is visible as the fat pad slides off the heel. Custom orthotics are used to normalize mechanics by slowing down the speed and amount of frontal plane motion that occurs with excessive pronation, thus decreasing the fat pad shearing. I will include a deeper heel cup to sequester the fat pad.

In the situation where a patient under pronates, the custom orthotic can be used to provide shock attenuation and, once again, enclose the fat pad. By providing shock attenuation, the force on the calcaneus will be reduced.

Shoe wear is also important. A shock absorbing cushion category shoe is needed for a patient who lacks pronation and therefore shock attenuation, while a Guidance or stability shoe is needed for someone who demonstrates excessive pronation.

A patient with a fore foot valgus is unable to attenuate force – but they may have eversion available that is currently not utilized. In these cases, another aspect to consider is subtalar mobilization: if the subtalar joint does not move appropriately, manual therapy can improve this. Barring a tarsal coalition, I have had good success with this strategy; the key is to maintain mobility after it is gained, so a home program of self-mobilization and exercise is important. For example, I have patients perform a hurdle stretch in standing with the calcaneus everted by using a towel on the lateral aspect of the foot. This will encourage eversion and maintain the motion gained, fostering pronation and potentially shock attenuation, and decreasing fat pad shearing.

OK, I know what everybody is thinking… what about fat transplants and/or injections, similar to the Hollywood diva lip enhancement? To my knowledge, fat injections are not lasting and augmentation is less than effective. The complex structure of the heel fat pad makes it extremely difficult to replicate: it has two layers – a macrochamber layer and microchamber layer – and each has different functions. The macrochamber layer deforms with large loads, while the microchamber layer is much stiffer (6). Personally, I have seen one patient with a fat pad transplant - he

is somewhat better, but continues to have pain and requires custom foot orthotics with deep heel cups to manage it.

Heel Pain Syndrome

Heel pain syndrome is usually insidious, and can be found in both overpronated and underpronated feet. It is actually a tendonosis of the intrinsic muscle attachments at the medial calcaneal tubercle most commonly due to a faulty biomechanical profile. By nature of the condition, it is slow-progressing and typically long-standing before it becomes symptomatic. It is often manifested after a change in activity: for example, I see it with runners who increase mileage too quickly in training for a race.

Heel pain syndrome is commonly misdiagnosed as plantar fasciitis because pain is located at the medial calcaneal tubercle. True, this is the attachment for the plantar fascia, but also the attachment of several structures mentioned previously. A quick way to rule out the plantar fascia is to perform a windlass mechanism creating tension in the plantar fascia. If the medial calcaneal tubercle is no longer tender, the plantar fascia is ruled out as it is "protecting" the injured area.

Calcaneal stress fractures also need to be ruled out. I like to use a tuning fork. Keep in mind that bone scans here will typically be positive due to the inflammatory condition, and X-rays are not effective in diagnosing an acute stress fracture.

Management

Management of heel pain syndrome includes orthotic intervention to address abnormal foot motion. This can be an over the counter product or custom orthotic depending upon the severity of the abnormal motion. The goal is to evenly distribute ground reaction force across the bottom of the foot, eliminating the areas of high pressure which can cause the symptoms. In addition, appropriate shoes based on the foot characteristics are important, in order to foster shock attenuation for an underpronating foot and control for an overpronating foot.

Activity management is important as well. I give my patients the goal of limiting their heel pain to 0-3/10 on their own analog scale. By keeping the pain level at 3/10 or less, they avoid propagating the injury and keeping it constantly irritated. This goes a long way towards allowing patients to participate in the activities that augment their mental and physical health while not making their condition worse. It also gives them a sense of accountability for their care.

Another important consideration is weight management. Clearly, the heavier someone is the more force that is placed on the plantar aspect of their foot, including the heel. Even if a patient is only able to lose five pounds, that loss is significant when you consider it in the context of the number of steps they take – in the era of fit bits, it is common for this to be 8-10,000 steps per day. That five pound loss adds up to a significant amount of force reduction!

Adequate flexibility is paramount for treatment of heel pain syndrome. Recall the windlass mechanism? In order for the plantar fascia to adequately support the foot, dorsiflexion needs to be available. Therefore, assessment of gastrocnemius and soleus flexibility as described in the evaluation portion is important. If limitations are noted, this needs to be improved.

> Non weight bearing stretching after periods of immobility is helpful to align scar tissue and decrease pain upon initial weight bearing: the deceptively simple dorsiflexion stretch, using a towel or belt, will go a long way here.
>
> Also, restrictions of the talocrural joint can limit dorsiflexion, and manual therapy can provide the arthrokinematics needed to improve it. Posterior mobilization of the talus in the talocrural joint is effective, but take care to rotate the lower leg such that the plane of the mobilization is maintained. If not, you'll wear your patient out physically without the desired effect of improved talocrural arthokinematics.
>
> Finally, don't underestimate the potential of rehab to improve the functional strength of the foot, leg, and hip musculature. We commonly tend to focus on the concentric when strengthening our patients, but eccentric strengthening is also key to appropriate function. With all of my foot and ankle patients I incorporate "whole leg" strengthening, including eccentric strengthening of the hip external rotators, which control motion of the LE and help to decrease abnormal stresses through the foot and ankle.

Nerve Entrapment

In cases where heel pain is being properly managed but the pain persists, an often-overlooked cause is a nerve entrapment.

Anatomy of the nerve orientation has been discussed previously. For review, the posterior tibial nerve courses at the medial ankle in the tarsal tunnel. This tunnel is formed by the medial wall of the calcaneus, posterior aspect of the talus, and medial malleolus. The flexor retinaculum is the roof of the tunnel. The posterior tibial nerve has three branches: the medial plantar nerve, lateral plantar nerve, and medial calcaneal nerve.

In regards to heel pain, the medial calcaneal and lateral plantar nerves are of particular interest. The medial calcaneal nerve innervates the medial aspect of the heel, medial plantar aspect of the foot, and abductor

hallucis muscle. The first branch of the lateral plantar nerve, also known as Baxter's nerve, supplies the periosteum of the medial calcaneal tuberosity, abductor digiti minimi, flexor digitorum brevis, and quadratus plantae. A common site of nerve entrapment of the first branch of the lateral plantar nerve is between the quadratus plantae and abductor hallucis.

Typically, with a nerve entrapment, pain grows worse with activity and towards the end of the day. Also, with a nerve entrapment, taping the heel will make the symptoms worse; thus, taping can be used diagnostically to differentially diagnose a nerve entrapment. Finally, a Tinel's sign at the site of the entrapment may be present, with resulting paresthesia.

Management

Management of any neural problem is difficult, as nerves and healing can be unpredictable. I have found that sometimes less is more: don't irritate the nerve further with aggressive exercise that reproduces patient symptoms.

Desensitization is an important first step, but a word of caution – make sure that you warn your patients that there may be an initial increase in symptoms as this process begins, or you will quickly lose their trust. Ice baths are one desensitization method: I instruct my patients to use an ice bath for up to 5 minutes, if they can tolerate it. I have also had success with using a contrast bath: the patient alternates submersing the foot in warm water for one minute, then ice water for 30 seconds, for a series of 5 repetitions (a miserable experience, and one that will not win you "Most Popular PT," but very effective at lessening the painful effects of an inflamed nerve). Neural flossing is another effective strategy: the idea is to mobilize the nerve and free it from entrapment through repetitive stretching. In some cases, immobilization with a boot may be required to calm the nerve down.

Another management technique for a nerve entrapment is a total contact custom orthotic. As previously discussed, the posterior tibial nerve courses through the tarsal tunnel; with excessive pronation, the tarsal tunnel can be compromised and the nerve compressed. A total contact custom orthotic can address excessive subtalar mobility, normalizing the amount of pronation; if the first branch of the lateral plantar nerve is irritated, relief for this area may need to be included in the orthotic to avoid further neural irritation.

If conservative methods fail and surgery is indicated, immediate post-operative neural mobilization is needed to avoid another entrapment during scar tissue formation.

Posterior Tibialis Tendonitis

Posterior tibialis tendonitis, often misdiagnosed as plantar fasciitis, can progress to Posterior Tibialis Dysfunction; this can be very debilitating, to the point where custom bracing is needed to provide relief and foster functional ability.

Anatomy of the posterior tibialis was discussed previously. The area of pain is at the hypovascular zone just proximal to the navicular tuberosity – yes, not on the plantar aspect of the foot – and may mimic the discomfort arising from a nerve entrapment or fat pad shearing. The key to differentially diagnose this condition is to reproduce symptoms with contractile activities such as a single limb heel rise on the affected side.

Management

Unlike heel pain syndrome, this is an acute situation, at least initially, so immediate treatment includes rest and anti-inflammatory modalities. Often patients do not look for treatment at this point.

The posterior tibialis is perhaps the most important dynamic support of the arch, so once inflammation has subsided functional strengthening is very important, with a focus on the eccentric for both the calf and hip musculature.

> A couple of my favorite exercises for the posterior calf are eccentric calf raises and what we call a "nose reach." The eccentric calf raise is fairly self-explanatory: the patient will rise up on both feet and then descend in a controlled manner on the affected side (if the patient is not initially able to control their body weight, a leg press can be used). The nose reach is performed by placing the affected foot approximately 12 inches from a wall. While maintaining an upright posture, the patient will translate their body towards the wall bringing their nose as close as they can without losing their balance. They should feel their toes "grab" the ground, followed by an exercise-induced strain to the posterior calf.
>
> In terms of hip eccentric strengthening, rotational lunge walks are very effective.

A goal I set with my patients is for them to be able to perform a single limb heel rise with control: by doing this, they are demonstrating the functional strength of the posterior calf musculature, which includes the posterior tibialis.

Often with posterior tibialis tendonitis, flexibility deficits of the calf musculature exist; we have gone into detail how this can be detrimental, so make sure flexibility is improved via appropriate use of static and dynamic calf stretches. (A quick tangent, with my apologies: One of my favorite questions to ask my patients is "Have you been doing your homework?" Regardless of the answer, it is readily apparent when

a patient is less than compliant with their home program. We as health care professionals need to get our patients involved and hold them accountable for being an active participant in their care. If they don't buy in and are not willing to put the work in at home, our chances of being successful greatly diminish. Calf stretching is a great example of this. It is very easy to perform, but it really needs to be done 3-5 times a day. The patient home program compliance plans of "once or twice a week "or "every now and then" are not going to facilitate any positive results. The key is to be consistent, daily.)

Also, custom foot orthotics and appropriate shoe wear help manage this problem. Typically, stress to the posterior tibialis occurs with a foot that over pronates. Therefore, the orthotic is made to decrease this faulty mechanical problem. Appropriate shoe selection used in conjunction with the custom foot orthotics are used to protect the posterior tibialis. By normalizing the foot and ankle mechanics, abnormal stress to the posterior tibialis tendon can be reduced.

V. MANAGEMENT

Evidence-based treatment validates what we do as physical therapists. We've already considered various strategies for managing plantar foot pain in the context of specific diagnoses – now, what recent research supports them?

Talocrural joint restriction, whether due to joint restriction or flexibility deficits, is often a cause of plantar foot pain, and it has been demonstrated that limited ankle dorsiflexion is associated with plantar foot pain (14). We know that joint mobilizations and stretching work to improve ROM limitations – in fact, we address this every day: if it is tight we stretch it, if it is stuck we make it move. So it comes as no surprise to any physical therapist that manual therapy and gastrocsoleus stretching does in fact improve ankle dorsiflexion (8). Earth shattering, I know!

However, a related finding is interesting to note: in management of heel pain, manual therapy plus exercise produced more favorable outcomes than modalities plus exercise (2). The best tools that we have as physical therapists are those that are attached to our wrists!

Stretching has been shown to both improve function and decrease pain in patients suffering from plantar heel pain (7, 15). There is also evidence that prolonged static stretching can help reduce plantar foot pain, supporting the use of night splints (1), and Sharma et al. (16) demonstrated that both static and dynamic stretching decrease pain and improve function in patients with plantar foot pain. (However, in the real world, patients often have difficulty tolerating wearing the splint all night; make sure they understand that if the splint is removed, the positive effect is diminished.)

Recall that the deep hip external rotators are intimately related to controlling excessive pronation of the foot and ankle, which results in abnormal stress to the structures on the plantar aspect of the foot and pain. As such, failing to include hip strengthening in a program for successful management of plantar foot pain would be detrimental to the goal of full functional return. It's been shown that when hip external rotator strengthening is employed, individuals with overpronation demonstrate more effective stair climbing ability (5); this result supports the clinical importance of hip strengthening in the rehab of plantar foot pain.

The research widely supports the implementation of eccentric strengthening; for example, Yu et al. (18) demonstrated that eccentric strengthening is more effective than concentric strengthening in the treatment of Achilles tendonopathy. These findings are repeated often in the literature, with eccentric strengthening of the hip external rotators and posterior calf musculature proven effective in the management of plantar foot pain.

There are both detractors and supporters of the use of custom foot orthotics, and conflicting research in regards to their efficacy. The use of custom foot orthotics has been found to decrease foot and knee pain in overpronating runners (17); Lewis et al. (11) and Landorf et al. (10) achieved similar effects. It's also been demonstrated that the total contact nature of custom foot orthotics helps them to redistribute abnormal plantar pressures and decrease pain (12) – this is the old bed of nails theory: when the circus magician lays down across a thousand nails, he smiles; however, if he did the same across two nails, he would have a less than stellar day!

Evidence supports the use of prefabricated orthotics as well in managing plantar foot pain (10). The disadvantage of a prefabricated orthotic is just that – it is prefabricated – therefore, it is not total contact and does not afford the same benefit of a custom orthotic as described above. An advantage is that they are less costly and they still provide some control to the foot. I often use a prefabricated device in youth as their feet will change rapidly with growth, making a custom product less than cost effective.

VI. CONCLUSION

As we've seen, there are many causes of plantar and heel pain, all of which are characterized by different symptoms, and all of which require varying management strategies if full functionality is to be restored. Plantar fasciitis is just one of a host of valid diagnoses – as a physical therapist, you owe it to your patients to consider all of them.

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HEEL PAIN: LOOKING BEYOND PLANTAR FASCIITIS
(1 CE Hour)
FINAL EXAM

1. **The _____ inserts into the distal phalanx of the first toe, while the flexor digitorum longus attaches to the distal phalanx of the two through five.**
   a. Abductor digiti minimi
   b. Abductor hallucis
   c. Flexor digitorum brevis
   d. Flexor hallucis longus

2. **When a patient presents with foot or lower extremity problems, a quick biomechanical screen will determine if a further in depth foot and ankle evaluation is warranted. Actions checked in standing may include _____.**
   a. Pronation/supination
   b. Quarter squat
   c. Single and double heel rise
   d. All of the above

3. **With the patient supine, the therapist should evaluate _____.**
   a. Malleolar torsion and first toe extension
   b. Resting calcaneal stance position
   c. Tibial angle
   d. Varus or valgus orientation of the rear foot and fore foot

4. **In the case of fat pad atrophy, when the fat pad is sequestered and the central heel is palpated, the symptom of tenderness to palpitation is _____,**
   a. Increased
   b. Not affected
   c. Reduced
   d. Variably affected

5. **Which of the following does NOT describe heel pain syndrome?**
   a. It can be found in both overpronated and underpronated feet
   b. It is often manifested after a change in activity
   c. It is slow-progressing
   d. It typically becomes symptomatic very quickly

6. **Typically, with a nerve entrapment, pain grows worse _____.**
   a. During rest
   b. Upon initial weight bearing after periods of non weight bearing
   c. With activity and towards the end of the day
   d. None of the above

7. **Posterior tibialis tendonitis is an acute situation, at least initially, so IMMEDIATE treatment includes _____.**
   a. Functional strengthening
   b. Improving flexibility via appropriate use of static and dynamic calf stretches
   c. Rest and anti-inflammatory modalities
   d. Surgery

8. **With _____, taping the heel will make the symptoms worse.**
   a. A nerve entrapment
   b. Fat pad atrophy
   c. Heel pain syndrome
   d. Posterior tibialis tendonitis

9. **In management of heel pain, manual therapy plus exercise produced _____ modalities plus exercise.**
   a. Equivalent outcomes to
   b. Less favorable outcomes than
   c. More favorable outcomes than
   d. None of the above

10. **The research widely supports the implementation of eccentric strengthening; for example, _____ demonstrated that eccentric strengthening is more effective than concentric strengthening in the treatment of Achilles tendonopathy.**
    a. Landorf et al.
    b. Lewis et al.
    c. Sharma et al.
    d. Yu et al.

ANSWER SHEET

First Name: _____ Last Name: _____ Date: _____

Address: _____ City: _____

State: _____ ZIP: _____ Country _____

Phone: _____ Email: _____

License/certification # and issuing state/organization _____

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Graduate Student: University name and expected graduation date _____

** See instructions on the cover page to submit your exams and pay for your course.

By submitting this final exam for grading, I hereby certify that I have spent the required time to study this course material and that I have personally completed each module/session of instruction.

Heel Pain: Looking Beyond Plantar Fasciitis
Final Exam

1. Ⓐ Ⓑ Ⓒ Ⓓ	3. Ⓐ Ⓑ Ⓒ Ⓓ	5. Ⓐ Ⓑ Ⓒ Ⓓ	7. Ⓐ Ⓑ Ⓒ Ⓓ	9. Ⓐ Ⓑ Ⓒ Ⓓ
2. Ⓐ Ⓑ Ⓒ Ⓓ	4. Ⓐ Ⓑ Ⓒ Ⓓ	6. Ⓐ Ⓑ Ⓒ Ⓓ	8. Ⓐ Ⓑ Ⓒ Ⓓ	10. Ⓐ Ⓑ Ⓒ Ⓓ

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HEEL PAIN: LOOKING BEYOND PLANTAR FASCIITIS

(1 CE HOUR)

COURSE EVALUATION

Learner Name: _____

	Disagree				Agree	
Orientation was thorough and clear	1	2	3	4	5	
Instructional personnel disclosures were readily available and clearly stated	1	2	3	4	5	
Learning objectives were clearly stated	1	2	3	4	5	
Completion requirements were clearly stated	1	2	3	4	5	
Content was well-organized	1	2	3	4	5	
Content was at or above entry-level knowledge	1	2	3	4	5	
Content was substantiated through use of references, footnotes, etc.	1	2	3	4	5	
Content reflected stated learning objectives	1	2	3	4	5	
Exam assessed stated learning objectives	1	2	3	4	5	
Exam was graded promptly	1	2	3	4	5	
Satisfied with learning experience	1	2	3	4	5	
Satisfied with customer service (if applicable)	1	2	3	4	5	n/a

What suggestions do you have to improve this program, if any?

_____

_____

What educational needs do you currently have?

_____

_____

What other courses or topics are of interest to you?

_____