Conservative Treatment of Posterior Tibial Dysfunction

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Posterior tibial dysfunction is a seriously disabling condition of the lower extremity. It can cause significant pain, weakness, and progressive development of flatfoot deformity. Since posterior tibial dysfunction is such a potentially serious lower extremity pathology, it is critical that the podiatrist understand the anatomy and function of the posterior tibial muscle, understand the nature of its progressive pathology, and also understand the clinical methods by which to properly assess the strength and integrity of the posterior tibial muscle/tendon complex. The purpose of this article, therefore, will be to provide a review of the anatomical, functional, and clinical aspects of posterior tibial dysfunction, and also to describe the authorþs conservative treatment protocol which has been developed in the course of the treatment of over 300 patients with posterior tibial dysfunction.

The posterior tibial muscle originates from the posterior aspects of the tibia, fibula, and interosseous membrane as the deepest muscle in the deep posterior compartment of the leg. The PT tendon courses posterior to the medial malleolus within the confines of the flexor retinaculum, just slightly posterior to the ankle joint axis. As the PT tendon continues inferior to the medial malleolus, it passes medial and plantar to the subtalar joint (STJ) axis and plantar to the oblique midtarsal joint (OMTJ) axis. Just posterior to the navicular tuberosity, the tendon divides into three components: anterior, middle and posterior. The anterior component is the largest of the PT tendon components, sending insertions to the navicular tuberosity and plantar aspect of the first cuneiform. The middle component inserts deeply in the plantar arch of the foot onto the second and third cuneiforms, the cuboid, and onto the bases of the second through fifth metatarsals (the fifth metatarsal insertion is sometimes absent). The posterior component branches laterally and posteriorly and inserts onto the anterior aspect of the sustentaculum tali.1

Because of the anatomical location of the posterior tibial tendon in relation to the ankle joint, STJ and OMTJ axes, contraction of the posterior tibial muscle will cause a plantarflexion moment across the ankle joint axis, a supination moment across the STJ axis, and a supination moment across the OMTJ axis.2,3 Due to its multiple insertions on nearly all the bones of the lesser tarsus and metatarsals, and its ability to exert substantial supination moments across both the OMTJ and STJ axes, the posterior tibial muscle has a critical function in weightbearing activities. Loss of normal posterior tibial muscle function due to either a partial or complete tear in the posterior tibial tendon, or a restriction of the normal gliding motion of the posterior tibial tendon within the flexor retinaculum commonly results in the

Behavioral Objectives

After reading this continuing education article, the podiatric physician should be able to:

1. Describe the anatomy of the posterior tibial muscle/tendon and its important relationships to the mechanical axes of the joints of the ankle and foot.

2. Understand the etiologic categories of posterior tibial dysfunction.

3. Understand how medial deviation of the subtalar joint axis affects the pronation moments acting across the subtalar joint axis during weightbearing activities.

4. Describe the ligaments in the foot that may become permanently deformed by the pronation moments that exist in the foot with posterior tibial dysfunction.

5. Be familiar with the physical findings commonly found in posterior tibial dysfunction.

6. Be capable of performing the modified posterior tibial muscle/tendon test on patients with posterior tibial dysfunction.

7. Be able to describe the conservative treatment protocol for patients with posterior tibial dysfunction.

8. Understand the mechanical importance of appropriate shoegear in the treatment of posterior tibial dysfunction.

9. Understand the mechanical importance of the specific orthosis design features that are commonly used in the treatment of patients with posterior tibial dysfunction.

progressive development of a flatfoot deformity, which is known as posterior tibial dysfunction.

Mueller has classified posterior tibial dysfunction into four etiologic categories. Type I is "direct" where direct injury to the tendon results in dysfunction of the posterior tibial tendon. Type II is "pathologic rupture" which is caused by primary tendon degeneration such as is seen in rheumatoid arthritis. Type III is "idiopathic rupture" where the etiology is unknown. Type IV is "functional rupture" where the posterior tibial tendon is intact but not functioning appropriately. Included within the etiologic categories of posterior tibial dysfunction are partial or a complete rupture, stenosing tenosynovitis, or pathologic elongation of the collagen fibers of the posterior tibial tendon.[4]

With posterior tibial dysfunction, posterior tibial muscle contraction is unable to generate adequate tensile forces in the posterior tibial tendon. The reduction in the ability of the posterior tibial muscle to generate adequate tensile forces in its tendon also causes a reduction in the ability of the posterior tibial muscle to produce supination moment across the STJ axis. Because of the reduction of STJ supination moment, increased STJ pronation motion will result during weightbearing activities since ground reaction force (GRF) acting on the weightbearing plantar structures lateral to the STJ axis cause increased STJ pronation moment (Fig. 1). Increased pronation motion of the STJ will, in turn, result in increased medial deviation of the STJ axis since the STJ axis medially translates and internally rotates in relation to the ground during pronation motion of the STJ.[3,5]

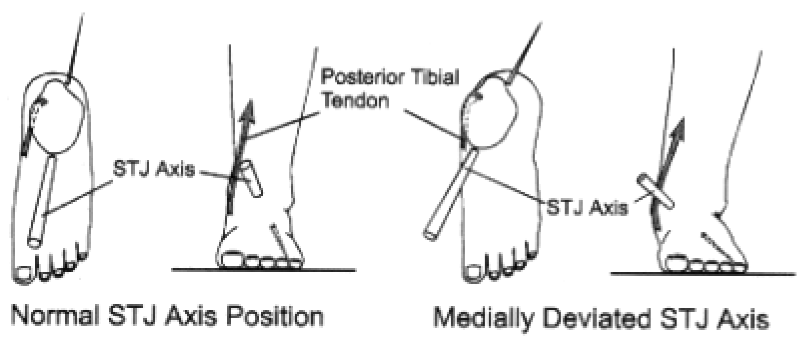

Figure 1. In the foot with a normal subtalar joint (STJ) axis location, the posterior tibial (PT) tendon is positioned well medial to the STJ axis so that PT muscle contractile activity causes a relatively large STJ supination moment (left). However, in the foot with posterior tibial dysfunction, the STJ axis becomes progressively more medially deviated due to the pronation motion of the STJ that causes internal rotation and medial translation of the STJ axis (right). As the STJ axis becomes more medially deviated, the moment arm that the PT muscle has available to produce STJ supination moment progressively shortens. The result of PT dysfunction is, therefore, a decreased ability in the PT muscle to generate STJ supination moment, a net increase in STJ pronation moment and the progressive development of a flatfoot deformity. (Reproduced with permission from Kirby KA: Etiology of flatfoot deformity in posterior tibial dysfunction. Precision Intricast Newsletter. Precision Intricast, Inc., Payson, Arizona, March 2000.)

The medial deviation of the STJ axis that occurs with posterior tibial dysfunction causes two effects. First, it causes decreased supination moment arms for GRF, muscular contractile forces and ligamentous tensile forces to generate STJ supination moments. Second, it causes increased pronation moment arms for GRF, muscular contractile forces and ligamentous tensile forces to generate STJ pronation moments.[2,6] The net result, therefore, is an overwhelming pronation moment acting across the STJ axis during weightbearing activities which not only causes the STJ to become maximally pronated but also tends to increase the deforming forces on many of the ligamentous structures of the medial ankle and the medial longitudinal arch of the foot.3, 7

Inherent in the progressive development of flatfoot deformity seen with posterior tibial dysfunction is a pathologic elongation of the spring ligament complex on the plantar and plantar-medial aspects of the talonavicular joint (TNJ). The spring ligament complex consists of the more medially located superomedial calcaneonavicular (SMCN) ligament and more laterally located inferior calcaneonavicular (ICN) ligament. Together, these two ligaments form a "sling" or a "talar acetabulum" for the talar head which act to support the talar head during STJ pronation motion.8

Both the SMCN and ICN ligaments normally resist the plantarflexion and adduction of the talar head at the TNJ during the extremes of STJ and OMTJ pronation motion.9 Normally, phasic contraction of the posterior tibial muscle produces tension in the posterior tibial tendon which helps to intermittently reduce the tensile loading force on the SMCN and ICN ligaments which, in turn, helps prevent overload, plastic deformation, and failure of these ligaments. However, posterior tibial dysfunction causes both an increased magnitude of STJ pronation moment, due to the medial STJ axis deviation, and also a reduction in the ability of the posterior tibial tendon to intermittently unload these important ligaments.3

As a result, progressive elongation of the spring ligament complex occurs which allows the rearfoot to undergo more plantarflexion and adduction movement relative to the forefoot during weightbearing activities than would be normally possible.8 This progressive relative adduction of the rearfoot on the forefoot causes further STJ axis internal rotation in relation to the weightbearing structures of the forefoot. This further lengthens the pronation moment arm which GRF on the plantar forefoot has available to cause pronation moment which, in turn, further increases the magnitude of STJ pronation moment during weightbearing activities.3

Therefore, the lack of normal posterior tibial muscle/tendon function directly causes plastic deformations or failure in the ligaments of the TNJ complex in posterior tibial dysfunction.8 In addition, the other ligaments of the foot and ankle which are subjected to increased tensile loading forces by the increased STJ pronation moments, such as the deltoid ligament of the medial ankle, and the plantar ligaments of the medial longitudinal arch of the foot, will also tend to undergo these same plastic deformations.4 The ultimate result of this lengthening of the supporting ligaments of the STJ, TNJ and medial longitudinal arch is the progressive and disabling flatfoot deformity commonly seen in posterior tibial dysfunction.

Physical examination of the patient with posterior tibial dysfunction reveals tenderness and edema along the course of the posterior tibial tendon, generally from the medial malleolus to the navicular tuberosity. Weightbearing examination of the foot demonstrates significant collapse of the medial longitudinal arch, increased convexity of the medial midfoot, and excessively abducted position of the forefoot relative to the rearfoot. During the heel rise test, the patient generally has difficulty performing the maneuver on the affected side and their heel may not invert normally while the ankle is plantarflexing during the test.10-12

The author has found that the most important and clinically reliable test when assessing for the possibility of posterior tibial dysfunction is accomplished by directly testing both the integrity and strength of the posterior tibial muscle/tendon complex. In order to properly test the strength of the posterior tibial muscle and the integrity of the posterior tibial tendon simultaneously, the author uses a variation of the standard posterior tibial muscle test (Fig. 2). This test allows for the isolation of the posterior tibial muscle from the rest of the muscles that can generate STJ supination moment so that the relative strength of the posterior tibial muscle alone may be assessed. In addition, the test allows for the examiner to clinically estimate the tensile force in the tendon which helps to assess the integrity of the posterior tibial tendon.13 The procedure will be described using the patient's right foot and lower extremity, with the examiner in a seated position.

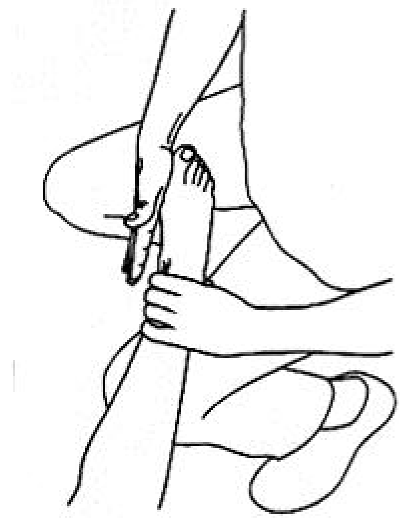

Figure 2. To properly assess both the strength of the posterior tibial muscle and integrity of the tendon, the examiner simultaneously tests the adduction-plantarflexion strength of the foot while palpating the posterior tibial tendon. (Reproduced with permission from Kirby KA: Technique for testing of the posterior tibial muscle/tendon complex. Precision Intricast Newsletter. Precision Intricast, Inc., Payson, Arizona, February 2000.)

First, have the patient sitting with their leg hanging over the end of the chair or table. The examiner then grasps the right foot, partially extending the patientþs knee, and rests the posterior-lateral aspect of the patientþs proximal ankle on the examiner's left distal thigh. The examiner then asks the patient to plantarflex approximately 450 at the ankle. From this position, the examiner uses their right hand to press on the medial-plantar aspect of the distal first metatarsal and rests their left hand on top of the medial aspect of the ankle, with their index and middle fingers resting on the posterior tibial tendon. Therefore, the right hand is used to determine the posterior tibial muscle strength and the left hand is used to determine the integrity of the posterior tibial tendon (Fig. 2).

The patient is then asked to push the examinerþs right hand as hard as possible in a medial-plantar direction. Once the patient starts to adduct and plantarflex the foot into the examinerþs hand, the examiner must make certain that flexion of the hallux and lesser digits does not occur which indicates assistance from the flexor hallucis longus and/or flexor digitorum longus muscles. In addition, to help prevent the anterior tibial muscle from assisting during the test, the patientþs ankle should be plantarflexed at the beginning of the test and the examiner's right hand should be on the medial-plantar aspect of the first metatarsal, not on just the medial aspect of the first metatarsal.

In order to determine the relative strength of the posterior tibial muscle, the amount of force that the examinerþs right hand exerts to prevent adduction and plantarflexion of the foot must be noted. In addition, during the examination, the fingertips of the left hand are used to palpate the posterior tibial tendon along its course both distal and proximal to the medial malleolus. Any development of palpable tension within the posterior tibial tendon during the examination indicates that there has not been a complete rupture of the tendon. A patient with normal posterior tibial muscle strength will develop sufficient tension within the posterior tibial tendon during this test so that even firm pressure on the tendon will not allow significant movement of the tightened tendon. Combining both the assessment of posterior tibial muscle strength along with the assessment of posterior tibial tendon integrity into the same examination greatly improves the ability of the physician to assess both the functional capacity of the posterior tibial muscle and the prognosis for complete healing of pathology of the posterior tibial muscle/tendon complex.13

Once the patient has been diagnosed with posterior tibial dysfunction, I spend a longer time than normal on patient education, including a description of the disease, what types of treatment will be used, what they will expect from treatment, and, very importantly, what I will expect from them. They understand that before treatment is initiated, that the treatment protocol will include icing, bracing, stretching exercises, strengthening exercises, prescription foot orthoses and hiking boots or other similar boots. The result of the increased understanding of the disease and treatment protocol that occurs with an extended patient education process is invaluable at achieving optimum treatment results in patients with posterior tibial dysfunction.

Since patients with posterior tibial dysfunction invariably have significant edema, tenderness and other signs of inflammation localized to the area of the posterior tibial tendon, they are started immediately on icing therapy to promote a reduction in the inflammation around the tendon. I typically have the patient ice for twenty minutes over the area of tendon swelling, two to three times a day. Icing greatly helps reduce the pain, inflammation and especially the edema around the posterior tibial tendon area. The cold therapy should be continued throughout the treatment period, generally ending about three months after they receive their prescription foot orthoses.

Stretching exercises for the gastrocnemius and soleus muscles are often also initiated if the patient has a restriction in ankle joint dorsiflexion. In addition, strengthening exercises for the posterior tibial muscle are often begun after the patient has been wearing the foot orthoses and hiking boots for about three weeks. Patients are also given the option of using oral nonsteroidal anti-inflammatory medication to reduce the inflammation, pain and swelling associated with the disease.

Patients are generally casted for prescription foot orthoses as soon as possible once they have been diagnosed with posterior tibial dysfunction. During the weeks while the patient is waiting for the prescription foot orthoses to be dispensed to them, I generally either place them into a weightbearing below- the-knee fiberglass cast or a walking brace/boot to further reduce the inflammation in the posterior tibial tendon area. The fiberglass cast is excellent at immobilizing the foot and ankle, but the ankle cannot be iced effectively while in the cast. The walking brace/boot often does not immobilize the foot and ankle enough to make the tendon asymptomatic, but icing can be continued since the walking brace/boot is removable.

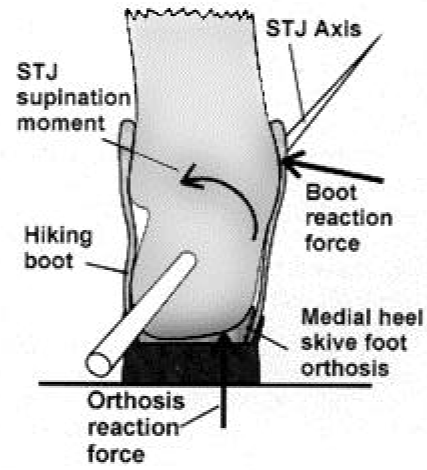

Figure 3. Illustrated above is a posterior view of a left foot with posterior tibial dysfunction and a medially deviated STJ axis. The foot orthosis with a medial heel skive and the hiking boot act synergistically to increase the magnitude of supination moment across the subtalar joint axis. Note that the foot orthosis can only exert a STJ supination moment by acting inferior to the STJ axis while the hiking boot can exert a STJ supination moment by acting superior to the STJ axis. (Reproduced with permission from Kirby KA: Shoes and therapy in the treatment of posterior tibial dysfunction. Precision Intricast Newsletter. Precision Intricast, Inc., Payson, Arizona, May 2000.)

Patients informed that they will need prescription foot orthoses are also told that they will need to wear a hiking style boot (or other structurally similar boot) with the foot orthoses in order to achieve optimum treatment results (Fig. 3). The hiking boots I recommend are the typical nylon and leather upper (or all leather upper) boots with hard rubber soles, modest heel height differentials, and with the upper extending just above the malleoli. These can be bought in most sporting goods stores. Hiking boots are prescribed for patients of all ages, both male and female. I expect patients to wear the foot orthoses with the hiking boots any time that they are standing or walking and I expect the boots to be worn with the orthoses for at least the first three months of foot orthosis therapy.14

From the outset of treatment, the patient is told that the combination of the hiking boot and the orthosis is just like part of a brace that is being prescribed. Patients understand that their chances of obtaining treatment success by only wearing the foot orthosis without the hiking boot, or only wearing the hiking boot without the foot orthosis, will be much less than if they wear the foot orthosis with the hiking boot together at all times. I believe that the reason that I have excellent patient compliance with these recommendations, even in patients of both sexes who are fifty years and older, is because they are told from the outset that hiking boots are a critical part of their successful treatment.

I recommend hiking boots for patients with posterior tibial dysfunction simply because patients have less pain and can walk with less discomfort earlier on in their orthosis treatment than when walking with more typical low-cut oxford style shoes. Hiking boots, unlike low-cut shoes, have the distinct mechanical advantage that they can directly cause STJ supination moment by acting superior to the STJ axis.15 This is in contrast to a prescription foot orthosis which only causes STJ supination moment by acting inferior to the STJ axis by redirecting the reaction forces on the plantar foot from lateral to medial.7,15,16 Therefore, hiking boots work synergistically with the medial heel skive foot orthosis to increase the STJ supination moments in the patient with posterior tibial dysfunction which, in turn, reduces the strain on the posterior tibial tendon and improves the patientþs symptoms and mobility (Fig. 3).

In order to prevent the structural changes, such as increased medial longitudinal arch collapse and increased abduction deformity of the forefoot on the rearfoot, it is critical that the pathologic forces that cause posterior tibial dysfunction be neutralized as early as possible in the course of the disease. In all of the feet that I have treated with posterior tibial dysfunction there has been very significant medial deviation of the STJ axis17 when compared to a normal foot or when compared to the patientþs unaffected foot. Therefore, due to the relatively unusual biomechanical makeup of feet with posterior tibial dysfunction, the prescription foot orthosis must be designed to not only increase the magnitude of STJ supination moment but also to decrease the magnitude of STJ pronation moment which results from medial deviation of the STJ axis.7, 15, 16 These specially modified prescription foot orthoses are the cornerstone of effective conservative treatment of posterior tibial dysfunction.

Specific orthosis positive cast modifications which I commonly use for patients with posterior tibial dysfunction include a 3-6 mm medial heel skive, minimal medial arch fill (i.e. minimal thickness of medial expansion plaster), and an inverted balancing position of between 2-60. Orthosis plate modifications include using a 3/16" to 4/16" shell, with an 18-20 mm heel cup height and a 40/40 rearfoot post. In addition, I order for the orthosis lab to make the orthosis plate wider than normal and to leave the heel contact point of the orthosis 1/8" thick, which is thicker than normal.

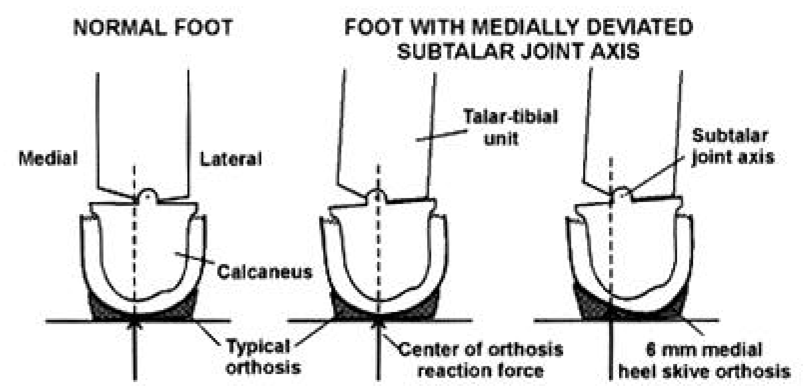

Figure 4. In a normal foot standing on a typical orthosis, the center of orthosis reaction force (ORF) on the calcaneus is medial to the subtalar joint (STJ) axis, creating a STJ supination moment (left). In a foot with a medially deviated STJ axis, such as that seen in a foot with posterior tibial dysfunction, the center of ORF remains relatively stationary to the plantar calcaneus while the STJ axis has translated medially (center). However, when the foot with a medially deviated STJ axis is standing on a 6 mm medial heel skive orthosis, the center of ORF is shifted medially which causes a relative increase in STJ supination moment when compared to the typical orthosis (right). (Reproduced with permission from Kirby KA: Orthosis modifications for treatment of posterior tibial dysfunction. Precision Intricast Newsletter. Precision Intricast, Inc., Payson, Arizona, April 1998.)

The purposes for the various positive cast modifications are as follows. The medial heel skive technique is combined with the minimal medial arch fill and inverted balancing position of the positive cast to increase the STJ supination moment by shifting the orthosis reaction force acting on the plantar calcaneus from a more lateral position to a more medial position.7,15,16 In mild posterior tibial dysfunction, I will generally use a 3 mm medial heel skive and a 2-40 inverted cast balancing position. In moderate to severe posterior tibial dysfunction I will use a 4-6 mm medial heel skive and a 3-60 inverted balancing position (Fig. 4). The theory is to increase the magnitude of STJ supination moment exerted by the orthosis on the plantar foot by using larger medial heel skives and inverted balancing positions as either the medial deviation of the STJ axis is increased or as the symptoms are increased.

The varus heel wedge of the medial heel skive works synergistically with the increased medial longitudinal arch height from the inverted balancing position to add both more pronation control and more comfort to the orthosis.15, 18

There are several purposes for the various plate modifications of the orthosis. The 18-20 mm heel cup height is necessary to prevent any lateral heel irritation that may result from the heel sliding laterally on the heel cup of the orthosis when the medial heel skive and increased medial arch height in the orthosis. The increased thickness of polypropylene plate is necessary to prevent excessive deformation of the orthosis since lower medial arch height orthoses will deform more under given loads than orthoses with higher medial arch height.19 In addition, the weight of the patient and the amount of medial STJ axis deviation will also alter my orthosis plate selection. The more medial the STJ axis location, the lower the medial longitudinal arch height and the heavier the patient, the more likely I will use 4/16" polypropylene.

The rearfoot post helps give the orthosis plate more sagittal plane and frontal plane rigidity.20 Increased rigidity of the orthosis is necessary to prevent deformation of the orthosis plate during the latter half of midstance and to decrease the strain on the posterior tibial muscle/tendon complex during this phase of gait. The increased width of the orthosis plate helps place more surface area of the orthosis medial to the STJ axis which not only helps the orthosis exert greater magnitudes of STJ supination moment but also helps prevent medial edge irritation from the orthosis.15

Finally, the increased heel contact thickness is necessary since most patients with posterior tibial dysfunction also have an equinus deformity. The increased heel contact thickness is used to decrease the tension in the Achilles tendon during the late midstance phase of gait which, in turn, will decrease the magnitude of STJ pronation moment during late midstance and reduce the strain on the posterior tibial muscle/tendon complex.20 In addition, by increasing the heel contact thickness, there will be decreased likelihood that the patient will develop the relatively common complaint of medial arch irritation from the orthosis since the decreased STJ pronation moment prevents the foot from pronating as hard into the medial arch of the orthosis during the late midstance phase of gait.15

The above outlined clinical approach and conservative treatment of posterior tibial dysfunction produces very effective results. In the four to eight new patients I treat monthly with all levels of severity of posterior tibial dysfunction, approximately 75 percent of them have at least a 75 percent reduction in the pain associated with weightbearing activities and are able to walk or stand at least six hours per day. Of course, conservative treatment is much more likely to result in success if the disease process is not at its end stage.

In those patients with more advanced stages of posterior tibial dysfunction who may not have successful response to the above treatment protocol, then they are given the options of either foot surgery or the use of a more supportive brace (i.e. double steel upright hinged ankle brace with a medial T-strap attached to a lace-up oxford style shoe) in combination with the foot orthosis. It has been my experience that of all the patients treated conservatively with posterior tibial dysfunction, less than 5 percent of these patients require surgical intervention, with the vast majority being very pleased with their conservative treatment results. The successful conservative treatment of posterior tibial dysfunction can occur in most cases, as long as the podiatric physician has the knowledge, technical skills and desire to carry out the treatment protocol that has been described above.

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1. Which of the following is not true regarding the anatomy of the posterior muscle and its tendon:

a. it originates from the tibia
b. it originates from the fibula
c. it originates from the inter osseous membrane
d. its tendon passes lateral to the subtalar joint axis

2. Contraction of the posterior tibial muscle causes which of the following:

a. it causes a dorsiflexion moment across the ankle joint axis
b. it causes a pronation moment across the subtalar joint axis
c. it causes a supination moment across the subtalar joint axis
d. it causes a pronation moment across the oblique midtarsal joint axis

3. Which of the following is not in Muellerþs etiologic categories for posterior tibial dysfunction:

a. indirect
b. idiopathic rupture
c. pathologic rupture
d. functional rupture

4. The medial deviation of the subtalar joint (STJ) axis which occurs with posterior tibial dysfunction causes which of the following:

a.an increase in the STJ supination moments from ground reaction force
b. an increase in the STJ pronation moments from ground reaction force
c.a decrease in the STJ pronation moments from ground

reaction force
d. no effect on the STJ moments from ground reaction force

5.The spring ligament complex of the talonavicular joint normally resist which motions of the talar head at the talonavicular joint:

a. plantarflexion and abduction
b. dorsiflexion and abduction
c. dorsiflexion and adduction
d. plantarflexion and adduction

6. The progressive elongation of the spring ligament complex seen with posterior tibial dysfunction causes which of the following to occur:

a. plantarflexion and adduction of the rearfoot relative to the forefoot
b. plantarflexion and abduction of the rearfoot relative to the forefoot
c. increased external rotation of the subtalar joint axis
d.an increase in the magnitude of subtalar joint supination moment

7. Ligaments which tend to undergo plastic deformation in posterior tibial dysfunction other than the spring ligament complex include:

a. anterior talofibular ligament
b. deltoid ligament
c. cervical ligament
d. calcaneofibular ligament

8. Which of the following physical examination findings are not found in posterior tibial dysfunction:

a. increased concavity in the media l midfoot
b. tenderness along the course of the posterior tibial tendon
c. significant collapse of the medial longitudinal arch
d. excessively abducted forefoot relative to the rearfoot

9. In the modified posterior tibial muscle test, which of the following is true:

a. it allow s for testing of both the posterior tibial and peroneal muscles
b. it can only be used in feet without posterior tibial tendon pathology
c. it only allows for assessing the integrity of the posterior tibial tendon
d. it allow s for isolated testing of the posterior tibia l muscle from the other muscles of the lower extremity

10. When performing the modified posterior tibial muscle test, which of the following is true:

a. the ankle of the patient is kept at 900 to the tibia
b. one hand of the examiner is placed on the dorsal-medial aspect of the distal first metatarsal
c. one hand of the examiner is placed on the lateral aspect of the ankle
d. the fingers of one hand of the examiner are placed on the posterior tibial tendon

11. To prevent the anterior tibial muscle from assisting during the modified posterior tibial muscle test, the examiner must perform the following:

a. have the patientþs ankle dorsiflexed at the beginning of the test
b. have the patientþs ankle at 900 to the tibia at the beginning of the test
c. position their hand on the medial-plantar aspect of the first metatarsal
d. position their hand on the medial-dorsal aspect of the first metatarsal

12. Conservative treatment of posterior tibial dysfunction does not include the following:

a. stretching exercises
b. over the counter arch supports
c. hiking boots
d. icing

13 . Icing the posterior tibial tendon in posterior tibial dysfunction does not accomplish the following:

a. reduce the pain around the tendon
b. increase the flexibility of the tendon

c. decrease the inflammation around the tendon
d. decrease the edema around the tendon

14. In the time immediately following casting the patient for prescription foot orthoses, what therapy is not recommended to the patient with posterior tibial dysfunction:

a. heat therapy
b. cold therapy
c. walking brace/boot
d. below-the-knee fiberglass cast

15. Which of the following is not true regarding the use of hiking boots in the treatment of posterior tibial dysfunction:

a. they greatly increase the chances of treatment success
b. they can work superior to the subtalar joint axis to exert a supination moment across the subtalar joint axis
c. they work synergistically with the medial heel skive orthosis to increase the supination moment across the subtalar joint axis
d. they need only be worn for the first three weeks of foot orthosis therapy

16. Foot orthoses designed for posterior tibial dysfunction must be designed to accomplish which of the following:

a. increase the magnitude of subtalar joint supination moment
b. increase the magnitude of subtalar joint pronation moment
c. decrease the magnitude of subtalar joint supination moment
d. increase the magnitude of ankle joint dorsiflexion moment

17. Common positive cast modifications used for prescription foot orthoses in posterior tibial dysfunction include the following:

a. a 1-2 mm medial heel skive
b. an inverted balancing position of between 2- 60
c. extra medial arch fill or medial expansion plaster thickness
d.a 3-6 mm lateral heel skive

18. Common orthosis plate modifications used for prescription foot orthoses in posterior tibial dysfunction include the following:

a. a 2/16" polypropylene shell
b. a 20/20 rearfoot post
c. a more narrow than normal orthosis plate
d. an 18-20 mm heel cup height

19. The purpose of increased thickness of orthosis plate material in the treatment of posterior tibial dysfunction is:

a. to increase the tightness of the shoe on the foot
b. to increase the flexibility of the orthosis
c. to prevent excessive deformation of the orthosis plate
d. to prevent the orthosis from breaking

20. The purpose of the increased heel contact thickness of the orthosis in the treatment of posterior tibial dysfunction does not include the following:

a. to decrease the tension in the Achilles tendon
b. to increase the magnitude of subtalar joint pronation moment during late midstance
c. to decrease the likelihood of medial arch irritation from the orthosis
d. to reduce the strain on the posterior tibial muscle/tendon complex

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