Posterior Tibial Tendon Dysfunction: A Review of Pain and Activity Levels of Twenty-one Patients

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ABSTRACT

Posterior tibial tendon dysfunction (PTTD), which results in painful pes planus, is a common clinical problem that requires careful orthotic management. The purpose of this study was to conduct a chart review and telephone survey to determine the effectiveness of orthotic treatment. In this preliminary study the authors define effective orthotic treatment as treatment that reduces pain and assists the patient in returning to pre-PTTD activity levels. When comparing orthotic management among foot orthoses fabricated from cork and pelite, UCB-type foot orthoses, and various types of AFOs, strong trends were noted. UCBs and AFOs reduced pain in five and seven subjects respectively, but only AFO management successfully increased activity levels of the subjects.

Key Words: Posterior tibial tendon dysfunction, pes planus, orthoses, ankle-foot.

First described in the orthopedic literature in 1969, posterior tibial tendon dysfunction (PTTD) can be caused by a partial or complete tear of the distal muscle tendon.[1] Since the initial report, several authors have commented on the presentation and progressive nature of this pathology in regard to orthotic and/or surgical management.[2-5]

This pathology is more common in middle-aged and older individuals. The progression is insidious and often unnoticed until significant deformity is present. Though rare, PTTD has been described in young athletes.[6] The mechanism of injury involves an excessive amount of stress placed on the tendon during rapid changes in direction, as in playing basketball or hockey.

The posterior tibial muscle originates at the proximal third of the tibia and interroseus membrane. The distal tendon takes a course that passes posterior to the medial malleolus. The muscle's tendonous insertions include the navicular, all three cunieforms, talonavicular capsule, cuboid, and corresponding metatarsals.[5] This muscle has a significant role in supporting the medial longitudinal arch; however, it is more the unopposed eversion action of the peroneal brevis that initiates the deformity than it is the absent inversion of the posterior tibialis.[2] Furthermore, the medial longitudinal arch does not necessitate muscle force to maintain it.[7] The bony anatomy and ligaments alone are sufficient for maintaining arch integrity until the presentation of muscle imbalance, as found in PTTD, slowly introduces a painful deformity.

In addition to its influence on the medial longitudinal arch, the posterior tibial muscle plantarflexes and inverts the foot. PTTD will cause collapsing of the medial longitudinal arch, subtalar eversion, valgus at the ankle, and forefoot abduction. There will be stretching of the spring and deltoid ligaments as well as the talonavicular capsule. Increasing equinus with progression and the possible development of contractures are also suspected.[5] The posterior tibialis initiates inversion and stabilizes the subtalar joint, allowing the gastrocnemius to plantarflex and invert the heel as the patient rises onto his/her toes. When the posterior tibialis is compromised, patients with PTTD will be unable to single-limb heel rise as the pathology progresses.

Several variables contribute to the etiology of this pathology. The PTTD patient often exhibits: obesity, hypertension, diabetes, previous trauma to the foot and ankle, and steroid treatment in the area of the posterior tibial tendon. Holmes and Mann found that obesity, diabetes, and hypertension were common clinical diagnoses in this patient population, noting higher incidences than found in the general population.[8]

Frey concluded that there is an area of hypovascularity in the tendon just distal to the area of the tendon that courses around the medial malleolus.[9] He attributes this finding to the sharp angle the tendon takes as it courses around the medial malleolus. This hypovascularity is not seen in the flexor digitorum longus, which takes a common path around the medial malleolus.

Clinical Presentation

During orthotic evaluation, the patient might verbalize that he or she has been experiencing pain on the medial aspect of the ankle, secondary to the stretching of the medial ligaments and soft tissues. Severity of valgus angulation should be measured and the orthotist should note if medial edema is present from repetitive stretching and traumatizing of the area (Figure 1a , Figure 1b , and Figure 1c). If the patient is progressing, pain will develop laterally as the fibula impinges on the calcaneus. Muscle testing inversion strength and single-limb heel rise are helpful in determining severity of the problem as well as in developing the orthotic plan.

Figure 1A. Dysfunction of posterior tibial tendon is manifested in ankle valgus. Forefoot abduction is also noted by more than two lateral toes viewed posteriorly.

Figure 1B. When the medial longitudinal arch begins to collapse, discomfort is primarily felt medially as ligamentous structures are attenuated.

Figure 1C. As the medial longitudinal arch collapses fully, pain is felt laterally secondary to impingement of the distal fibula on the calcaneus. Note that it becomes difficult to discern individual medial bony prominences with progression of deformity.

The orthotist should be aware of the classification specifics of Myerson.[11] This classification is an adaptation of Johnson and Strom's staged classification.[10] Stage I involves patient complaints of medial pain and edema. The patient can still perform a single-limb heel rise and has a flexible hindfoot. Orthotic treatment options include medial heel and sole wedges, arch support, and articulated AFOs. In stage II, individuals present with heel valgus and cannot perform single-limb heel rise. Pain is now present on the lateral aspect of the ankle. Orthotic treatment is the same as that in stage I, with the addition of more rigid arch supports. With progression to stage III, the hindfoot is now rigid, and solid ankle AFOs are suggested. Finally, stage IV is distinguished by a valgus angulation of the talus with rigid AFO management as the orthotic treatment.

The only other finding in the literature pertaining to orthotic treatment was an abstract and paper presented by Chao, et al., to the American Academy of Orthopaedic Surgeons.[11] The authors found that PTTD "can be effectively treated with aggressive conservative management using molded ankle foot orthoses and UCB inserts." In addition ,"67% of the subjects had results that were considered good to excellent based on pain, function, use of an assistive device, distance of ambulation and patient satisfaction." While all the papers reviewed were informative, there was a lack of solid orthotic observations in regard to what to expect and how to treat these patients. Questions of pain and activity levels with orthotic management encouraged the authors to review cases seen in their clinic and to observe similarities and differences within this patient population.

Methodology

A chart review and telephone survey was conducted of all patients under the direct care of the authors for a period of 11 months. No statistical tests were performed during this case review due to the variety of treatments. Comparisons among foot orthoses fabricated from cork and pelite, UCB-type foot orthoses, and AFO users were made. Variables reviewed were patients' age, side affected, sex, duration of orthotic treatment, weight, incidence of diabetes, and hypertension. The authors were particularly interested in activity level and pain level with orthotic treatment. Though subjective, activity level and pain level prove to be good measurements of the effectiveness of orthotic treatment from the patient's perspective. In regard to activity level, some patients, as noted in the results, expressed that they were able to walk further and for longer duration with orthotic treatment.

Results

Of the 25 patients seen, 21 were available for follow-up. The sample consisted of 17 females and 4 males with a mean age of 57 years. After calculating a body mass index for each patient, 86% were found to be overweight for their height and age,[12] 24% were diabetic, and 62% were hypertensive. Three individuals presented with deformity bilaterally.

Orthotic treatment was determined by the prescribing orthopedic surgeon, usually as an effort to avoid surgery. All patients described varying levels of both medial and lateral pain before treatment, indicating that orthotic management was initiated late, often after bed rest, short leg cast, or pain-management injection treatments failed.

Foot Orthoses Fabricated with Cork and Pelite

Orthoses in this group were fabricated with an arch support and 5º medial wedge. This group consisted of six subjects with a mean duration of treatment of 7.2 months (4- to 10-month range). Three individuals in this group perceived their condition as good since the initiation of orthotic treatment. One subject was within the average weight range and another would not discuss weight characteristics. The other four individuals averaged 36.8 pounds over the upper limit of the average weight range. Activity level increased in only one subject and pain decreased in three subjects.

UCB-Type Orthoses

Orthoses in this group were posted medially, and relief for the prominent plantar aspect was made accordingly. This group consisted of six subjects with a mean duration of treatment of 6.2 months (1- to 9-month range). Five individuals in this group stated that they were doing well and not progressing. Only one subject was within the average weight limits. The other five subjects were an average of 48.2 pounds overweight. Activity level increased in one subject and pain decreased in five subjects.

AFOs

Three different types of AFOs were used, as deemed appropriate after evaluation of the patient's needs. All AFOs incorporated a valgus-controlling trimline (Figure 2).

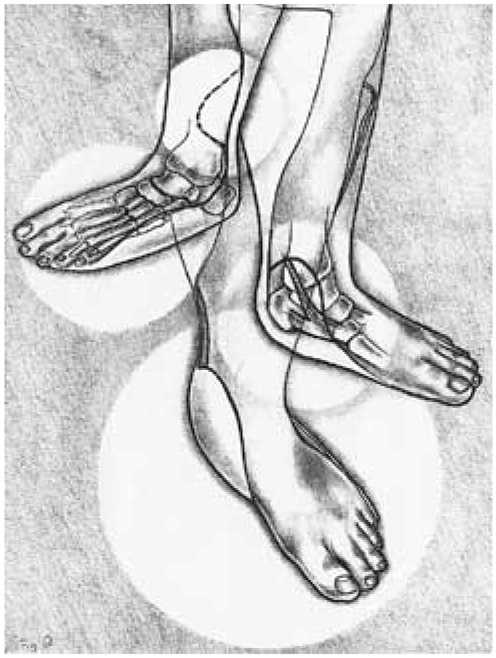

Figure 2. Valgus-controlling trimlines rely on a laterally directed force at the medial aspect of the ankle and a medially directed force at the forefoot. It is essential that the medial trimlines cover the medial malleolus and medial longitudinal arch, and that the lateral trimline extend distal to the fifth metatarsal head. Without proper trimlines, control may be lost. Additional control can be gained through a medially directed force proximal to the lateral malleolous.

Articulated AFOs were used in cases where the valgus present could be controlled with a minimal amount of surface area contact medially with a well-molded medial longitudinal arch support and where the hindfoot exhibited no pathological related rigidity. The ankle was free motion unless the physician anticipated the development of an equinus contracture. If this was the case, a 90º plantarflexion stop was included.

A dorsiflexion-assist AFO with valgus-controlling trimlines, as described by Smith,[13] was used when ankle motion needed no restriction and a UCB, or articulated AFO insert would not provide sufficient ankle control due to lack of medial surface area contact (Figure 3). The flexibility of this type of AFO seems to affect the function of the patient minimally and exhibits ground reaction forces to a lesser degree than solid ankle orthoses.

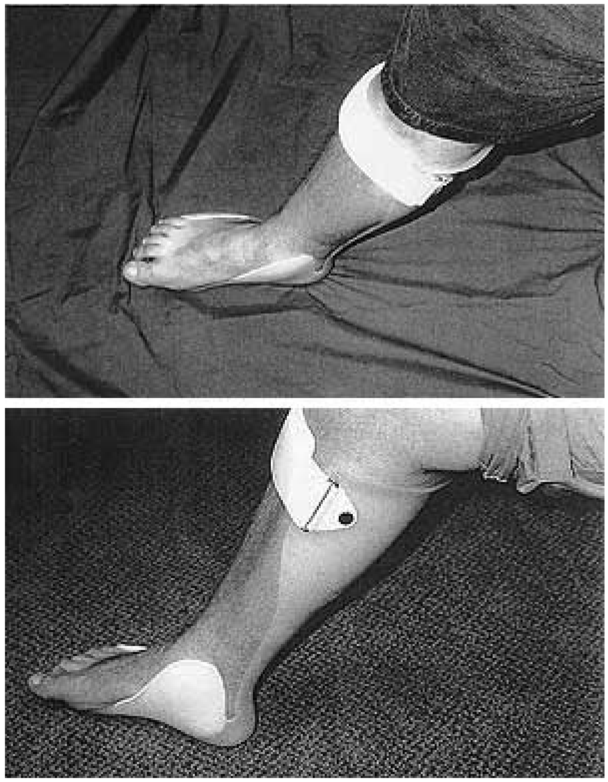

Figure 3. The dorsiflexion AFO with valgus-controlling trimlines. Transverse and sagittal views.

Solid ankle AFOs with valgus-controlling trimlines and neutral ankle alignment were used for patients who presented a rigid hindfoot, obesity, and extensive valgus angulation that required maximum control. No correction of deformity could be obtained in these patients. Seven subjects were studied in this group. (Originally there were eleven subjects; three had shoe conflicts and refused to acquire proper footwear, and one was attending an orthotic clinic closer to her home.) Mean duration of treatment was 5.6 months, with a range of 1 to 11 months. All seven subjects wearing their AFOs felt that they were doing well. One subject was within the average weight range; the others averaged 51 pounds over the superior limits of the weight range. Activity levels increased in six and pain decreased in all seven. Pertinent was the finding that four of the AFO subjects were previously managed in cork and pelite foot orthoses. These orthoses did not provide adequate control of the ankle valgus and allowed the deformity to progress.

Discussion

While pain reduction was evident in UCB type orthoses and AFO treatment, activity level was most influenced by AFO treatment. AFOs provided a greater degree of control over the ankle. As patient weight increased, so did the degree of orthotic control, indicating the careful consideration of this variable in orthotic design as well as in material selection.

The orthotist must be aware that, in many cases, the deformity that presents around the ankle should be accommodated more than corrected. The orthotist should specifically be aware that with progression of this pathology, the navicular becomes very prominent on the plantar aspect of the foot. Adequate relief is essential for patient comfort and success of treatment.

The authors find it particularly helpful to take a plaster impression with partial weight bearing to provide a more accurate impression of the plantar surface. It is necessary during the impression process to provide a low-durameter foam block on which the patient can bear weight. We have also found that the use of impression foam is not advantageous in the effective treatment of this pathology. It is difficult to determine bony alignment and adequately distinguish bony prominences using impression foam.

Padding the medial aspect of the orthosis will not only increase comfort but also allow for a soft and flexible correction, provided the positive model was modified accordingly. Insufficient modification will cause discomfort as the ankle is wedged medially/laterally within the orthosis.

The dorsiflexion-assist AFO with valgus-controlling trimlines provides more control by design than does the UCB-type orthoses. It has a lower profile than articulated AFOs, allowing it to fit more easily in shoes. Smith outlined a plastic thickness guide based on the patient's weight.[13] He suggests 1/8 inch for less than 100 pounds, 3/16 inch for 100 to 200 pounds, and 1/4 inch polypropylene for 200 to 300 pounds. Our experience has shown that simply varying the distal aspect of the medial trimline can increase the rigidity. As the trimline courses distally, there is a point where the trimline makes a 180º turn proximally to form the medial valgus control extension. If this point is located more superior and rigidity is increased, a wider range of weights can be accommodated with the same plastic thickness.

Conclusion

Orthotic management of posterior tibial tendon dysfunction requires careful consideration of progression of deformity and tolerable corrective forces. Orthoses must be fabricated with adequate relief of all medial bony prominences. Given the progressive and biomechanical nature of this pathology, a radiographical study comparing effectiveness of the above orthoses and any other orthoses deemed appropriate is necessary to develop definitive orthotic plans.

As orthotists, we try to provide adequate control without limiting the function or causing severe biomechanical consequences at other joints. This is noted if one should induce a rigid neutral ankle alignment while ignoring a knee flexion contracture, compromising the patient's balance. In the case of posterior tibial tendon dysfunction, insufficient control could lead to progression of the deformity. Orthotic management should be, as Chao[11] stated, "aggressive."

References:

1. Kettelkamp DB. Spontaneous rupture of the posterior tibial tendon. JBJS. 1969;51-A:4:759-764.
2. Mann RA, Coughlin, MJ. Surgery of the foot and ankle. 6th ed., Vol 1. Chicago: Mosby. 1993:757-784.
3. Teitz CC, et al. Tendon problem in athletic individuals. JBJS 1997;79-A:1:138-152.
4. Mann RA., et al. Rupture of the posterior tibial tendon causing flat foot. JBJS. 1985;67-A:4:556-561.
5. Myerson MS. Adult acquired flatfoot deformity. JBJS. 1996;78-A:5:780-792.
6. Conti SF. Posterior tibial tendon problems in athletes. Ortho Clinics of North America 1994;25:1:109-21.
7. Basmajian VJ, Stecko G. The role of muscles in arch support of the foot: an electromyographic study. JBJS. 1963;45-A:1184.
8. Holmes GB, Jr., Mann RA. Possible epidemiological factors associated with rupture of the posterior tibial tendon. Foot and Ankle. 1992;13:2:70-79.
9. Frey C., et al. Vascularity of the posterior tibial tendon. JBJS. 1990; 72-A:6:884-888.
10. Johnson KA, Strom DE. Tibialis posterior tendon dysfunction. Clinical Orthopedics. 1989;239:196-206.
11. Chao W, et al. Conservative management of posterior tibial tendon rupture. Orthopedic Transcriptions. 1994-95;18:1030.
12. Bray GA, MD. Obesity in America. U.S. Department of Health. NIH Publication # 79 - 359. Nov 1979:4-7.
13. Smith R. The AFO and ankle control-technical note. Orthotics & Prosthetics. 1979;33:1:46-8.

Source: Journal of Prosthetics and Orthotics 1999; Vol 11, Num 1, p 2
URL: http://www.oandp.org/jpo/library/1999_01_002.asp