PROLAB ORTHOTICS
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EFFECTIVE ORTHOSIS TREATMENT OF POSTERIOR TIBIAL TENDON DYSFUNCTION

In my previous ProLab newsletter, the biomechanics of the painful and disabling condition of posterior tibial tendon dysfunction (PTTD) was described in detail. In summary, most cases of PTTD seem to occur from relatively trivial injuries to the foot and/or ankle in patients who have feet that are already overly-pronated and with medially deviated subtalar joint (STJ) axes (Kirby KA: Methods for determination of positional variations in the subtalar joint axis. JAPMA, 77: 228-234, 1987). As a result of these injuries, the posterior tibial (PT) tendon is partially or completely torn and/or stretched which causes medial ankle tenderness and swelling, and weakness within the PT muscle/tendon complex. If left untreated, the foot and ankle deformity resulting from PTTD tends to be progressive with further flattening of the medial longitudinal arch, further abduction of the forefoot on the rearfoot and further medial deviation of the STJ axis. Much of the weakness of the PT muscle/tendon complex observed in PTTD is the result of reduction in the PT tendon supination moment arm which lessens its ability to create a supination moment with contractile activity of the PT muscle (Kirby KA: Conservative treatment of PT dysfunction. Podiatry Management, 19:73-82, 2000).

In my years of clinical practice, I have treated literally hundreds of patients with PTTD. During that time, I have experimented with many foot orthoses design variations in an attempt to achieve the optimum therapeutic treatment results for my patients. In this newsletter, I will detail what I have learned in treating patients with PTTD with custom foot orthoses during my nearly four decades of practice.

Since the PT tendon functions to generate a supination moment across the STJ with increased tension force within its tendon fibers, an injury to the PT tendon will tend to respond favorably to any therapeutic measure which lessens the tension force within the PT tendon. In addition, since all patients with PTTD have medially deviated STJ axes, feet with PTTD will invariably have excessive magnitudes of STJ pronation moments acting on them during their daily weightbearing activities, thereby increasing the demands on the posterior muscle/tendon complex. Therefore, the most logical biomechanical method of treating PTTD with foot orthoses should be directed toward lessening the tension within the PT tendon during weightbearing activities by counteracting the excessive STJ pronation moments acting on these feet with foot orthosis modifications which cause an increase in STJ supination moment.

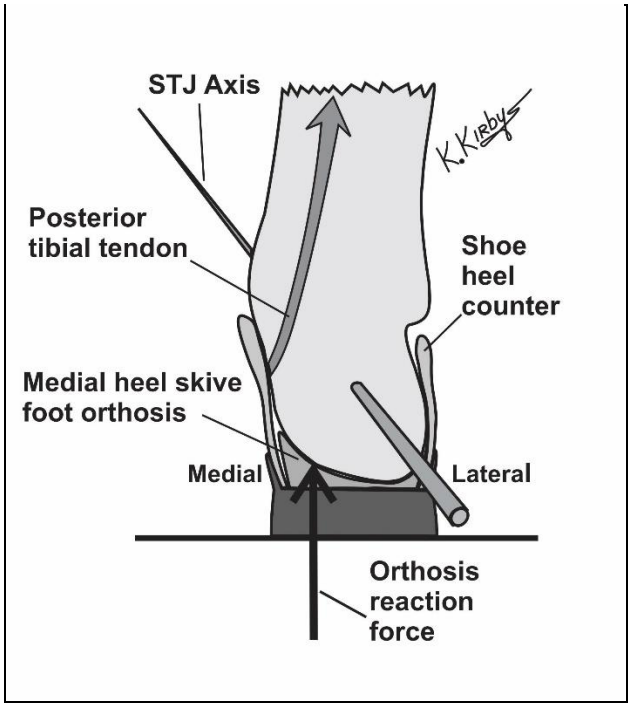

Figure 1. When a foot orthosis is made with a medial heel skive to treat posterior tibial tendon dysfunction, the varus-sloped heel cup will shift orthosis reaction force more medial relative to the subtalar joint (STJ) axis. The net mechanical result is an increase in STJ supination moment from the orthosis and a decrease in tension in the PT tendon, resulting in less medial ankle pain and better function.

Early on in my practice, from 1985-1989, my treatment for patients with PTTD involved using the Blake Inverted Orthosis Technique, invented by Richard Blake, DPM. The Blake Inverted Orthosis, with its varus-shaped heel cup, increases STJ supination moments which effectively decreases the functional demand on the PT muscle and tendon (Kirby KA, Green DR: Evaluation and Nonoperative Management of Pes Valgus, pp. 295-327, in DeValentine, S.(ed), Foot and Ankle Disorders in Children. Churchill-Livingstone, New York, 1992).

Then, beginning in 1990, I began experimenting with another foot orthosis modification, the medial heel skive technique, which also created a varus-shaped heel cup within the orthosis (Fig. 1). The medial heel skive orthoses that I made for my patients with PTTD effectively increased the STJ supination moments in the feet of these patients which significantly helped them to heal more rapidly from

their painful and disabling condition. After a year of experimentation with the medial heel skive technique, I wrote the paper that described this orthosis technique and its clinical effectiveness in the treatment of PTTD (Kirby KA: The medial heel skive technique: improving pronation control in foot orthoses. JAPMA, 82: 177-188, 1992).

In general, the foot orthosis shell material that works best in treating PTTD is polypropylene since it is very durable and, if made sufficiently rigid, will prevent deformation of the medial longitudinal arch of the patient over time. The thickness of the polypropylene shell used in orthoses made for the treatment of PTTD will depend on the body weight, the severity of the PTTD and the height of the medial longitudinal arch (MLA) of the patient. The heavier the patient, the more severe the PTTD (i.e., Stage 3-4 PTTD) and the lower the MLA height of the patient will require a thicker polypropylene shell (i.e., 5-6 mm). Patients who are less heavy, have Stage 1-2 PTTD and have a higher MLA height may only require a 4 mm polypropylene shell to resist the expected longitudinal arch deformation during gait that will occur in these patients.

Polypropylene rearfoot posts are always used in treating patients with PTTD in order to increase the durability of the orthosis and maximize the ability of the foot orthoses to resist frontal plane rotation of the orthosis in the shoe/boot. I will also order "minimum cast fill" and will invert the balancing position of the orthosis by 1-2 degrees in order to increase the MLA height of the orthoses. The amount of medial heel skive used is important in achieving treatment success with custom orthoses. In general, a 2 mm medial heel skive is used in patients with Stage 1 PTTD and a 4-6 mm medial heel skive is used with Stages 2-4 PTTD. The height and stiffness (i.e., resistance to deformation) of the orthosis MLA is also critical in effectively treating PTTD since the MLA of the foot orthosis works along with medial heel skive within the rearfoot portion of the orthosis to increase the STJ supination moment in the foot during weightbearing activities.

Research has demonstrated that the medial heel skive orthosis technique increases the pressure and force in the medial portion of the heel cup of the orthosis (Bonanno DR, Zhang CY, Farrugia RC, Bull MG, Raspovic AM, Bird AR, Landorf KB. The effect of different depths of medial heel skive on plantar pressures. Journal Foot Ankle Research. 5(1):20, 2012). In addition, an increased height and stiffness within the medial arch of the foot orthosis will shift ground reaction force (i.e., orthosis reaction force) acting on the plantar foot from a more lateral location to a more medial location. Since both the medial heel skive and increased height and stiffness of the orthosis MLA shifts ground reaction force (GRF) medially on the plantar foot, then both of these orthosis design modifications may be used by the clinician to increase the magnitude of STJ supination moment acting on the foot in patients with PTTD to improve the therapeutic effectiveness of custom foot orthoses. In other words, the medial heel skive technique and medial arch height/stiffness of custom foot orthoses work synergistically with each other to create an increase in STJ supination moment from the orthosis which will lead to better custom foot orthosis therapeutic outcomes when treating PTTD.

The other important conservative treatment consideration in patients with PTTD is the choice of shoe gear that is recommended to work along with their specially-designed custom foot orthoses. In patients with Stage 1 PTTD, an athletic shoe with a stiffer midsole or a firm-soled lace-up dress shoe may be sufficient to effectively treat the pain and disability caused by the patient's PTTD. However, in Stage 2-4 PTTD, the best conservative treatment results come from use of the specially-designed medial heel skive foot orthoses, described above, inside a high-top shoe or boot. The high-top shoe or boot has a mechanical advantage in that it can act both above and below the STJ axis to help resist the excessive pronation that is seen in PTTD. Since the custom foot orthosis can mechanically act only by shifting GRF medially on the plantar aspect of the foot, use of a high-top shoe or boot will always increase the clinical effectiveness of the foot orthoses in the treatment of PTTD. Alternatively, ankle-foot orthoses, such as the Richie Brace or Arizona Brace, which also brace the ankle above the STJ axis, can also be used for effective conservative treatment of PTTD.

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