Foot Drop Correction: By Active Dorsiflexion or Tenodesis Effect?

Commentary on an article by T. Dreher, MD, et al.: “Tibialis Posterior Tendon Transfer Corrects the Foot Drop Component of Cavovarus Foot Deformity in Charcot-Marie-Tooth Disease”

Michael S. Aronow, MD

In their excellent paper, Dreher et al. attempt to answer the question of whether their previously described total split posterior tibial tendon transfer (“T-SPOTT”) works as an active dorsiflexor of the ankle or merely maintains ankle dorsiflexion through a tenodesis effect. The authors report the results of their T-SPOTT procedure performed in conjunction with other soft-tissue or osseous procedures on fourteen limbs in fourteen patients with a cavovarus foot and foot drop related to Charcot-Marie-Tooth disease. They performed preoperative and postoperative three-dimensional gait analysis using their previously validated foot model with seventeen well-defined osseous markers on the foot and leg to measure tibiotalar motion (actually plantar flexion and dorsiflexion of a line between the calcaneus and the navicular relative to the tibia), foot-tibia motion (plantar flexion and dorsiflexion of a line between the calcaneus and distal aspect of the first metatarsal relative to the tibia), and the medial arch angle (angle between the first metatarsal and a line from the medial aspect of the calcaneus to the navicular).

The authors found that, at mean of twenty-nine months postoperatively, mean passive ankle dorsiflexion increased by 13° to 15° while mean passive ankle plantar flexion decreased 9°, which suggests a tenodesis effect of the T-SPOTT and other associated procedures. However, maximum tibiotalar and foot-tibia dorsiflexion increased during swing phase, suggesting that the tibialis posterior, which was previously quiescent during swing phase, may have changed its activation pattern and was firing during swing phase after the transfer, although the authors noted that adding dynamic electromyography to future studies would more definitively answer that question. During stance phase, maximum tibiotalar and foot-tibia plantar flexion decreased by 6° and 16°, respectively, which the authors felt could be due to a tenodesis effect or, alternatively, to plantar flexor weakness related to loss of tibialis posterior plantar flexion, disease progression, or cast immobilization. There was a decrease in cavus as measured by the medial arch angle during stance phase as well as the calcaneal pitch and talometatarsal angles on lateral standing radiographs. The AOFAS (American Orthopaedic Foot & Ankle Society) ankle-hindfoot score improved from 55 to 76, but the authors did not specifically state in their Results section whether the patients’ foot drop during gait resolved or ankle dorsiflexion strength improved.

By directly measuring “tibiotalar” dorsiflexion, the study design separates out the effect of osteotomy, arthrodesis, and soft-tissue procedures distal to the navicular that increase measured foot-tibia dorsiflexion through the forefoot and midfoot. However, since the T-SPOTT procedure involves transferring the tibialis posterior tendon to the tibialis anterior and either the peroneus tertius or the peroneus brevis, one might expect it to increase dorsiflexion, by either a tenodesis effect or active firing, at the tarsometatarsal and naviculocuneiform joints as well as the ankle and Chopart joints. Furthermore, some of the increases in measured tibiotalar dorsiflexion may be attributable to a change in marker locations in the few patients with concurrent hindfoot osteotomy or arthrodesis procedures or, alternatively, to alterations in the tension and strength of the extensor digitorum longus and/or extensor hallucis longus as a result of the Hibbs and modified Jones procedures more commonly performed by the authors.

Although the data suggest that the transferred tibialis posterior may increase tibiotalar dorsiflexion by both active firing and a tenodesis effect in patients with Charcot-Marie-Tooth disease, it may not be applicable to patients with foot drop secondary to other etiologies. Patients with deep peroneal nerve palsy, common peroneal nerve palsy, prior anterior compartment syndrome, L4 radiculopathy, or spastic equinovarus may have differing relative strengths in the muscles that dorsiflex the ankle. These patients may also have normal, weakened, spastic, or completely absent function in the peroneus longus and/or peroneus brevis, the muscles that invert the hindfoot and plantar flex the ankle, and the intrinsic muscles of the foot.

It also remains unclear which method of transferring the tibialis posterior tendon is the best for patients with foot drop. All or part of the tibialis posterior may be transferred. The transfer may be through the interosseous membrane, as done by Dreher et al., or circumtibial1. The transferred portion of the tendon may be inserted in one location or it may be split among two or more
insertions, as done by Dreher et al. The tibialis posterior tendon may be inserted into a variety of bones including the lateral cuneiform, cuboid, or navicular. Alternatively, it may be tenodesed to other tendons including the tibialis anterior, extensor hallucis longus, extensor digitorum longus, peroneus tertius, and/or peroneus brevis. The tenodesis to another tendon may occur either proximal or distal to the ankle, and in the latter case, it may be routed subcutaneously or deep to the superior and the inferior extensor retinaculum. Additional tendon transfers may be added, such as the peroneus longus in the Bridle procedure. Although there is still much to be learned, the authors should be commended for their work in beginning to answer these questions.

Michael S. Aronow, MD*
Orthopaedic Associates of Hartford,
Hartford, Connecticut

*The author received no payments or services, either directly or indirectly (i.e., via his institution), from a third party in support of any aspect of this work. Neither the author nor his institution has had any financial relationship, in the thirty-six months prior to submission of this work, with any entity in the biomedical arena that could be perceived to influence or have the potential to influence what is written in this work. Also, the author has not had any other relationships, or engaged in any other activities, that could be perceived to influence or have the potential to influence what is written in this work. The complete Disclosures of Potential Conflicts of Interest submitted by authors are always provided with the online version of the article.

References