Posterior Tibial Tendon Transfer

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KEYWORDS

• Equinovarus • Posterior tibial tendon transfer • PTTT • Tendon transfer
• Posterior tibial tendon • Dropfoot

KEY POINTS

- Proper tensioning of the tendon is key to maintaining the greatest amount of strength available from the transferred tendon.
- Patient education of rehabilitation and out-of-phase tendon training is paramount for success.
- Interosseous technique is recommended as opposed to the circumtibial route, creating a generous window in the membrane to allow for free movement of the tendon.
- Assurance of proper muscle strength and grade must be evaluated preoperatively to achieve success.
- Adequate tendon length must be demonstrated before passing the transfers.

INTRODUCTION

Tendon balancing using the posterior tibial tendon for the correction of a deforming drop foot disorder is both common and complex. It is a procedure that is often indicated in high-risk patients presenting with multiple comorbidities. Complications range in severity and depend on the underlying pathophysiology (flaccid paralytic

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disorders vs spastic cerebral palsy) of the deforming force and degree of flexibility. Rigid osseous deforming forces have been seen to coexist with soft tissue involvement, and when not corrected, often limit the tendon balancing effectiveness. This is because anatomic joint excursion under passive range of motion is decreased with tendon transfers. Perioperative management should include correcting osseous deformities before or in conjunction with tendon procedures and is paramount to a successful result. Patient education and the capacity of the patient to undergo extensive functional rehabilitation and muscle retraining are essential to achieve activate dorsiflexion during the swing phase of gait.[1] The ultimate goal of the tibialis posterior tendon transfer is to create a stable plantigrade foot thereby correcting the deforming force leading to inefficiency and/or instability during walking.[2] The hope is to obviate the need for an ankle foot orthosis or plantarflexion-limiting brace; however, patients should be aware that permanent bracing could be required, depending on whether the tendon transfer is functional versus a static sling, as well as the ability for other major muscle groups and intrinsic muscles to stabilize stance.

In 1937, Mayer discussed 5 principles of tendon transfer.[3] These 5 principles are paramount in obtaining a successful tendon transfer procedure. These principles include restoration of the anatomic relationship between a tendon and its sheath, tendon routing through the tissue that allows for gliding, restoring normal tendon tension, re-creation of the anatomic tendon insertion, and establishing a proper line of tendon pull.[3] In-phase tendon transfers are often thought of as the preferred, most effective, and efficient method. Out-of-phase transfers require greater length of retraining and therapy. It has been proposed that out-of-phase tendon transfers act solely as a static restraint to the deformity.[4,5]

The functions of the tendon, as well as the distance of the tendon from the joint axis, are important points to consider when planning a tendon transfer. The function of the tendon can be determined by its position in relation to the site or joint that is being considered. The distance from the joint is what determines the lever arm of force that can be applied across the joint. These musculotendinous structures work in pairs to counterbalance one another. They become antagonists to each other, allowing for the pull of one tendon to oppose that of the corresponding tendon. When one of these components becomes weak or loses its ability to function, a deformity is created owing to the antagonistic muscle/tendon. This becomes a key point when determining which tendon is to be transferred and to where it should be transferred.

Normal tension on the tendon is an important consideration when performing a tendon transfer. Studies show that fixating a tendon with too much or too little tension can lead to the tendon becoming ineffective.[6,7] Blix curve shows us that it is desired to have the tendon midway between maximal length and the relaxed position to allow it to generate the most effective pull.[8] This length allows for optimal myofilament overlap, which creates the maximal amount of force. Friden, in a study on upper extremity tendon transfers, found that using passive tension as a guide for the optimal length often results in overstretching of the sarcomeres, resulting in a loss of muscle strength.[7] Overtensioning, as opposed to undertensioning, is often the preferred technique for many surgeons when fixating a tendon that is transferred owing to the thought that the repair site may slip or stress–relax. However, relying on the repair site to relax or slip is not a recommended method owing to the fact it will often result in loss of strength.

ANATOMY AND BIOMECHANICS

Under normal physiologic conditions, the primary function of the tibialis posterior muscle/tendon (PTT) through its multiple attachments on the plantar aspect of the foot are