DROPFOOT — TENDON SURGERY

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PURPOSE

In this chapter we discuss the surgical indications and techniques of tendon surgery for the correction of dropfoot deformity. A thorough understanding of the principles of muscle-tendon surgery and tendon transfers is essential if optimal results are to be obtained surgically. Many factors must be considered. These include anatomy, physiology, function and healing of muscles and tendons, proper surgical technique and tendon handling, and many other factors described previously in this book.

An understanding of the etiology and classification of the dropfoot deformity is essential in the selection of the appropriate surgical procedures. It is wise for the patient and the surgeon to be realistic in determining the goals and expectations of the proposed tendon transfer surgery.

Definition And Classification

Dropfoot is a nonspecific term which refers to a condition involving the relationship of the foot to the leg in which there is paralysis or pronounced weakness of the extensor muscles. It is a complicated deformity which may present in varying degrees of severity depending on the etiology and progressive nature of the underlying disease. Most patients presenting with dropfoot deformity will have clinical evidence of neuromuscular disease.

The dropfoot condition can be classified as flexible or fixed depending on the severity and degree of contractures associated with the deformity. In the early stages, deformity usually presents as paralysis of the extensor muscles without any secondary osseous or structural deformities. Such soft tissue deformity responds well to various tendon transfer procedures.

For a tendon transfer to be effective, the deformity must be entirely flexible or non-osseous in nature or must be made flexible at surgery. Flexibility is determined preoperatively by examination of range of motion. The clinician should be able to demonstrate a reasonable range of passive motion to a corrected position or beyond.

The osseous or structural dropfoot is the most severe type of deformity and is commonly referred to as talipes equinus. It presents as a fixed or structural deformity in which there is inadequate range of motion to permit return to a corrected position. The rigid deformity is quite recalcitrant to treatment by tendon transfers. In some cases osseous or fixed deformities can be altered by joint releases, tendon lengthenings, osteotomies, and arthrodesis.

Not infrequently the fixed dropfoot deformity will require a pantalar or ankle arthrodesis in order to obtain an acceptable fixed position of the foot to the leg.

Tibialis Posterior Tendon Transfer

Indications:

In the presence of extensor muscle paralysis the tibialis posterior provides potential for good restoration of dorsiflexory power by transfer through the interosseous membrane to the dorsum of the foot. The normal function of the tibialis posterior muscle is in stance phase and its primary action is adduction and inversion of the foot. Transfer of the tibialis posteror tendon to the dorsum of the foot involves an out of phase muscle transfer in which the function of the muscle changes from stance phase muscle to swing phase.

Ideally in tendon transfer surgery it is best to transfer muscles within phase. However, the out of phase muscle transfer involving the tibialis posterior tendon has provided excellent functional results. It has been utilized at Doctors Hospital for more than twenty-five years on a continuing basis and is recommended for the following conditions:

1. Weak or paralyzed anterior muscle group
2. Non spastic equinovarus deformity
3. Recurrent clubfoot deformity
4. Dropfoot deformity
5. Charcot-Marie Tooth disease foot deformity
6. Permanent peroneal nerve palsy

Surgical Technique:

Review of the literature reveals three major techniques which have been utilized for transferring the tibialis posterior tendon to the dorsum of the foot in correction of the dropfoot deformity. One of the first procedures employed utilized three separate incisions. The first incision was made medially over the insertion of the tibialis posterior at the level of the navicular bone. Through this first incision, the tendon is identified and released from its insertion into the

navicular bone, with care to preserve as much length of the tendon as possible.

The second incision is located on the anterior aspect of the leg at the level of the middle and distal third just lateral to the crest of the tibia. Through this second incision the tibialis anterior muscle belly is identified and retracted from the lateral aspect of the tibia to the level of the underlying interosseous membrane.

Dissection in the area of the anterior compartment of the leg is relatively simple due to the well defined tissue layers. Exposure and separation of the anterior compartment of the leg to the level of the interosseous membrane proximally and distally is essential in facilitating transfer of the tibialis posterior through the interosseous membrane. The use of Army-Navy retractors helps to facilitate retraction of the tibialis anterior muscle belly and the neurovascular structures from the anterior aspect of the interosseous membrane. With vital structures retracted, a window is made by incising the interosseous membrane.

Extreme care must be taken to avoid damage to a second neurovascular bundle lying just posterior to the tibialis posterior muscle belly (Fig. 1). With careful blunt dissection and the use of curved Kelly forceps and moist sponges, the tendon and muscle belly of the tibialis posterior can be drawn through the opening in the interosseous membrane.

If resistance is encountered at this point the surgeon can facilitate transfer by releasing any slips of tendon or muscle that may be attached within the laciniate ligament or just proximally. A curved forceps can be pushed gently along the tendon and within the sheath to reflect loose attachments. There are often small segments of muscle fibers of origin distal to the window created in the interosseous membrane and these must be gently pulled free without traumatizing the neurovascular supply to the tibialis posterior tendon.

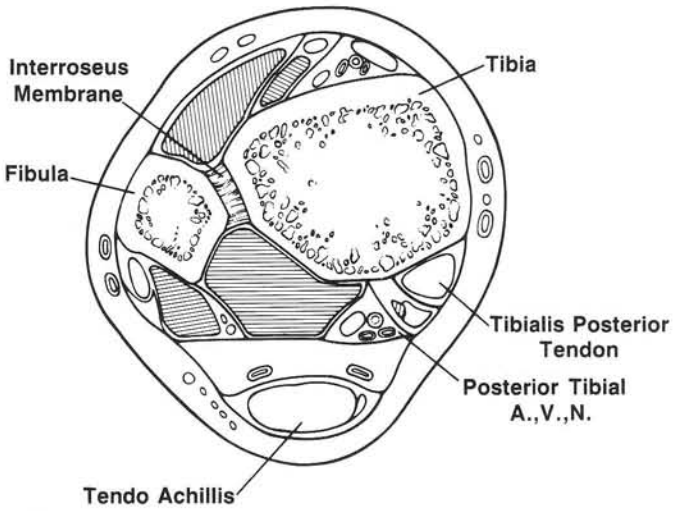


Fig. 1. Transfer of tibialis posterior requires careful dissection proximally to avoid damage to the neurovascular bundle. Close proximity of neurovascular structures is evidenced by this cross-sectional view of the leg.

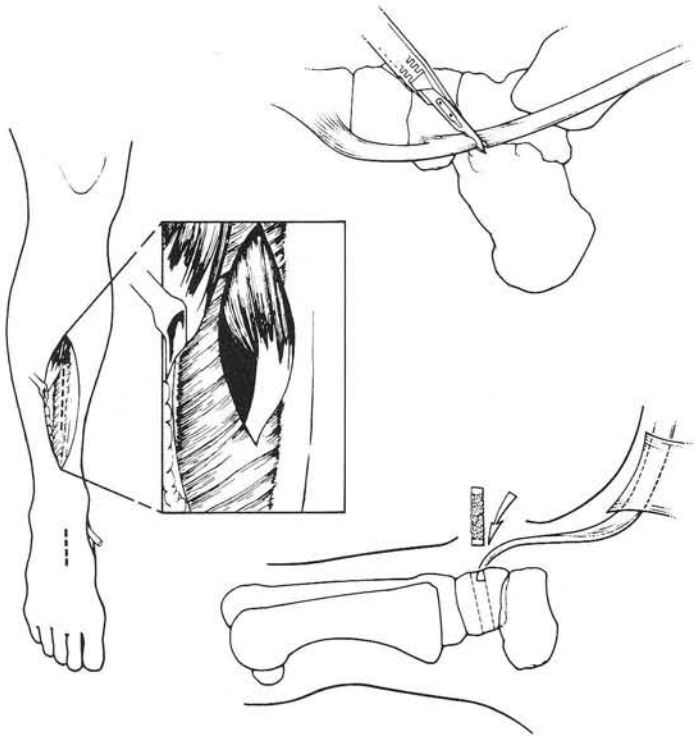


Fig. 2. Fixation of tibialis posterior to lateral cuneiform is depicted. This method is not commonly used at Doctors Hospital with tendon to tendon transfer being the currently preferred method.

The third incision is located on the dorsum of the foot at the level of the tendon to bone anastomosis. At this point, a forceps is inserted in a retrograde fashion through the third incision on the dorsum of the foot up the extensor sheath to the level of the second incision on the anterior aspect of the leg. The tibialis posterior tendon is then drawn distally through the extensor sheath to its new insertion.

In the original technique the transferred tibialis posterior is fixated to the second or third cuneiform with the foot held in a neutral subtalar position and with the ankle at a right angle to the leg (Fig. 2).

Depending on the severity of the deformity and the presence of forefoot varus or forefoot valgus, the surgeon may prefer to change the insertion of the transfer more medially or laterally. One of the complications associated with a more lateral insertion has been the development of excessive pes valgus postoperatively.

The second technique for tibialis posterior tendon transfer incorporates four separate incisions. The identical two procedures for release and attachment of the tibialis posterior tendon are performed but with the addition of a posterior medial incision on the leg to facilitate passage of the tendon through the interosseous membrane. This modifi-

cation helps to free the tibialis posterior from its attachments to the tibia. The incision on the anterior aspect of the leg is still necessary in order to draw the tendon distally utilizing the extensor compartment for transfer to the dorsum of the foot as described previously.

At Doctors Hospital an alternative to bony insertion of the tibialis posterior is used in most instances. The modification includes splitting the posterior tibial tendon membrane into medial and lateral halfs after transfer through the interosseous membrane. The lateral half of the tendon is passed down to the dorsum of the foot and attached to the peroneus tertius tendon near its insertion. The medial half is passed to the dorsum of the foot through the sheath of the tibialis anterior and attached to it near its insertion. (Fig. 3)

Splitting the tendon following transfer through the interosseous membrane results in a more balanced suspension with insertions medially and laterally. This modification has provided gratifying results and has avoided some of the postoperative complications of excessive valgus position which may be seen when the tibialis posterior tendon is inserted into the third cuneiform. Also tendon anastomosis following tendon surgery has the advantage of decreased postoperative care since tendon to tendon anastomosis will occur in 5-6 weeks in contrast to tendon to bone anastomosis which may require immobilization for 8-10 weeks.

Tendon anastomosis is also less traumatic to the patient in that dissection and tissue handling is decreased in contrast to tendon to bone anastomosis. Many proven techniques have been utilized at Doctors Hospital for fixation of transferred tendons.

The third technique for tibialis posterior tendon transfer uses the same two incisions for the release and attachment of the transferred tibialis posterior tendon. The major difference in the third technique is that the tendon is not transferred through the interosseous membrane but instead utilizes a posterior medial approach where the tendon is slid medially around the side of the bone from the posterior to the anterior aspect of the leg just anterior to margin of the medial malleolus. Care is then taken in this instance to draw the tendon and muscle anteriorly in order that the muscle fibers rather than the tendon are in direct contact with the medial tibia. On the anterior aspect of the ankle and foot, the tendon sheath of the extensor tendons may be utilized for directing the path of transfer of the tendon.

Although this procedure is technically easier to perform than the transfer of the tendon through the interosseous membrane the overall results have not been encouraging. One of the major reasons for the rather disappointing results is the inability to preserve the gliding mechanism of the tendon and the increased incidence of adhesions which restrict function and compromise the final surgical result.

Our preferred method is transfer of the tibialis posterior tendon through the interosseous membrane utilizing a split

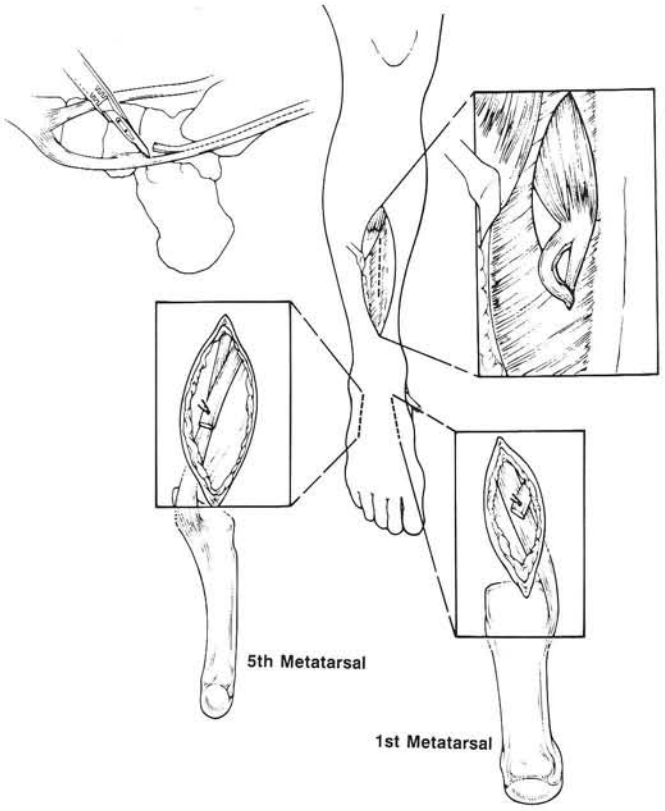


Fig. 3. Split transfer of tibialis posterior tendon involves releasing tendon from its insertion, retrograding tendon to proximal incision, passing tendon halves through tendon sheaths of tibialis anterior and peroneus tertius, and tendon to tendon anastomosis.

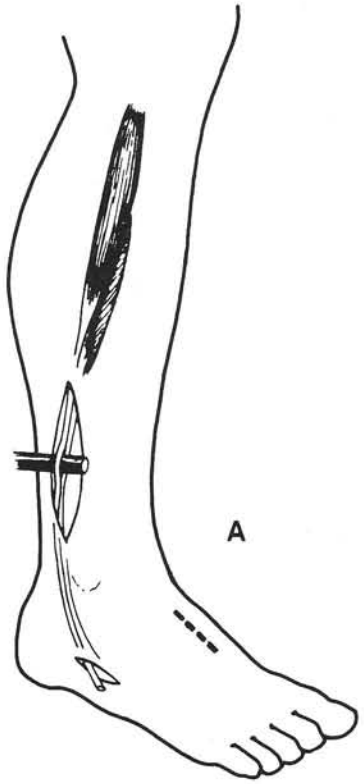
tendon transfer to the peroneus tertius tendon laterally and the tibialis anterior tendon medially.

Results and Complications:

Transfer of the tibialis posterior tendon through the interosseous membrane for correction of dropfoot has been an excellent procedure for the flexible dropfoot condition in the absence of osseous deformity. Most of the complications and poor results have been seen in more severe deformities involving structural or osseous deformity.

Proper patient selection and choice of procedure is essential in preventing compromised results. Transfer of the tibialis posterior tendon is not an acceptable procedure for correction of spastic equinovarus since the tibialis posterior transfer in this deformity can lead to secondary deformities.

One of the feared complications following transfer of the tibialis posterior tendon is a severe secondary pes valgo planus deformity. This complication is predictable in patients with available rearfoot eversion. It is a rare occurrence in the foot which cannot be everted past the perpendicular. In flexible feet the surgeon can prevent the complication



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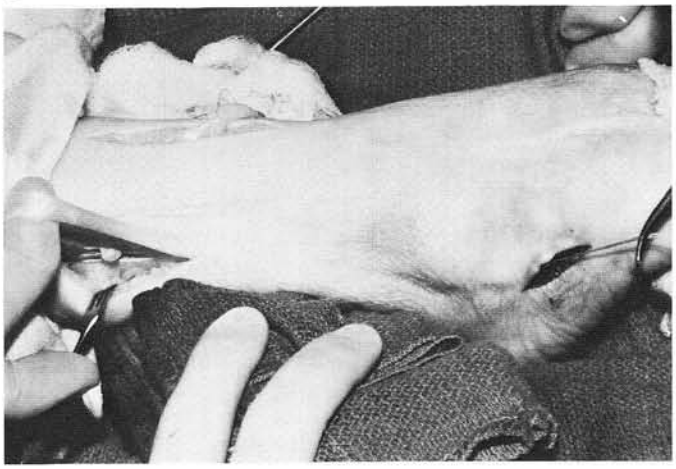

Fig. 4. Split peroneus longus tendon transfer is an alternative muscle-tendon balancing procedure for dropfoot correction. Incision planning and tendon to tendon anastomosis is depicted.

by performing an adjunctive arthrodesis to stabilize the subtalar and midtarsal joints against pronation. This may involve talonavicular or triple arthrodesis.

Overall the results following transfer of the tibialis posterior tendon in the treatment of the flexible or nonosseous dropfoot condition have been very gratifying and predictable. Our surgical approach has remained essentially unchanged for the past twenty-five years.

Peroneus Longus Tendon Transfer

Indications:

The peroneus longus is a strong muscle which often provides an effective tendon for transfer. Such transfers can be quite adequate in the treatment of flexible dropfoot deformity. The surgical technqiue for peroneus longus tendon transfer is similar to the technique described previously for transfer of the tibialis posterior tendon.

Technique:

Anatomically the peroneus longus tendon lies superficial to the peroneus brevis on the lateral aspect of the lower one third of the leg. The peroneus longus tendon transfer is usually performed through three separate incisions.

The first incision is placed over the lateral aspect of the lower one third of the leg directly over the peroneus longus tendon which can be palpated under the skin and quickly isolated.

The second incision is made along the calcaneocuboid joint where the peroneus longus runs inferior on the lateral aspect of the bone. The tendon can readily be identified at the second incision on the lateral aspect of the foot by placing the tendon under traction at the first incision site.

Following section of the peroneus longus tendon it is withdrawn through the first incision for transfer to the anterior compartment through the anterolateral intermuscular septum. Following the technique described previously in transfer of the tibialis posterior, the peroneus longus tendon is routed down the extensor tendon sheath, beneath the cruciate retinaculum. The tendon may be attached to the base of the third metatarsal, third cuneiform, or split into medial and lateral portions for anastomosis the peroneus tertius and tibialis anterior tendons near their insertions (Fig. 4A & B).

At Doctors Hospital the preferred method of securing the tendons is by anastomosis to the tibialis anterior and peroneus tertius tendons. The split tendon anastomosis helps to create a balanced suspension and in most cases a better functional result postoperatively.

Results and Complications:

The overall results with transfer of the peroneus longus tendon have been gratifying in treatment of the dropfoot deformity and other related anterior muscle group weakness. It has been particularly useful in patients where the tibialis posterior tendon is paralyzed or is of insufficient

strength to be considered as an isolated source of tendon transfer.

Complications following peroneus longus tendon transfer are similar to those described previously in transfer of the tibialis posterior tendon; though transfer of this tendon is unlikely to result in a valgus foot deformity.

Ankle Fusion

In the osseous or fixed dropfoot condition, tendon transfers are ineffective in correcting the deformity. In such instances a more aggressive approach involving arthrodesis is necessary to provide adequate correction. Such correction often involves ankle fusion or pantalar arthrodesis (Fig. 5).

Surgical correction of fixed dropfoot condition can be technically difficult. In contrast to tendon transfer the postoperative course and rehabilitation may be prolonged.

The emphasis here is on surgical correction of the flexible or nonosseous dropfoot condition and a detailed discussion of ankle arthrodesis is beyond the scope of this paper.

SUMMARY

Dropfoot deformity presents an interesting challenge to the podiatric surgeon. The surgeon undertaking treatment of the condition should have a thorough understanding of the etiology of the deformity as well as being well versed in the biomechanics of the involved part. Appropriate choice of technique is based on this knowledge. Of the procedures described, the tibialis posterior tendon transfer through the interosseous membrane with split anastomosis to the medial and lateral aspects of the foot have provided the most gratifying postoperative results.

Fig. 5. Pantalar arthrodesis was necessary in this patient with Charcot-Marie Tooth disease due to extensive paralysis of leg muscles. Tendon transfer would have been an insufficient means of stabilization in view of the extensive involvement.

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