

An Overview on Tibialis Anterior Tendon Transfer

**Muhammad Omar Misbah Balhaj, Mohamed Mansour Elzohairy, Ahmed Mohamed Abdelwahab
And Sherif Mohamed El Aidy**

Orthopedic Surgery Department, Faculty of Medicine, Zagazig University, Egypt

***Corresponding author:** Muhammad omar misbah balhaj

Email: muhammadbalhaj75@gmail.com,

Abstract:

Tibialis anterior tendon transfer is a well-established surgical procedure used to correct dynamic foot deformities, particularly recurrent clubfoot and spastic equinovarus conditions. These deformities are commonly caused by muscle imbalance, especially an overactive tibialis anterior muscle combined with weak antagonists. Both complete and split tendon transfer techniques aim to restore muscle balance, improve foot alignment, and enhance functional outcomes. Despite widespread use, optimal outcomes depend on proper patient selection, accurate preoperative assessment, and the integration of adjunctive procedures when necessary.

Keywords: Tibialis anterior tendon, tendon transfer, recurrent clubfoot, equinovarus deformity, STATT, muscle imbalance, orthopedic surgery

Introduction:

Tendon transfer procedures have long been used for the correction of complex foot deformities in adults and children. Because many deformities coexist, however, concomitant bony and soft tissue procedures are often necessary for successful correction. Transfer of the tibialis anterior tendon is used commonly to treat recurrent clubfoot and to restore muscle balance in patients with cerebral palsy. Recurrent club- foot deformities are often attributable to an overactive tibialis anterior muscle and weak antagonists. Although many techniques have been proposed for the correction of recurrent clubfoot deformities, the most common treatments include the complete and split transfer of the tibialis anterior tendon (1).

Complete transposition of the anterior tibial tendon was first described by **Garceau (2)** and later modified by Ponseti. The Ponseti technique popularized and is largely accepted as the standard treatment for the management of idiopathic club- foot. The technique aims to correct dynamic supination by transferring the tibialis anterior tendon laterally (3).

Several decades later, the split tibialis anterior tendon transfer (STATT) was introduced by Hoffer and colleagues. The STATT is a variation of the complete tibialis anterior tendon transfer where the tibialis anterior tendon is split and the lateral half is secured into the lateral cuneiform or cuboid. When initially introduced, the STATT procedure was used to treat children with cerebral palsy and spastic equinovarus deformity. Since then, the indications have expanded to include the treatment of residual clubfoot deformity as well as spastic equinovarus deformity in adults (4).

As with the complete transfer of the tibialis anterior tendon, the STATT procedure attempts to neutralize the varus pull of the tibialis anterior muscle. Both the complete and split transfers have proven safe and effective means of achieving deformity correction, restoring muscle balance, and improving functional autonomy (5).

Pathomechanics

Weak evertors allow the tibialis anterior muscle to have an unopposed pull creating a dynamic supination of the forefoot. Transferring the tendon laterally balances inversion and eversion and reduces the talo-first metatarsal angle (6).

Indications

Successful outcomes depend on appropriate patient selection and the indications for both the tibialis anterior tendon transfer and the STATT (1).

Contraindications

There are very few absolute contraindications to tibialis anterior tendon transfer. The procedure should be avoided when muscle strength of the tibialis anterior is less than 41 or 5 and when severe contraction limits tendon length and prevents the transfer of the distal end laterally. In rigid deformities, the procedure should not be performed in isolation (7).

SURGICAL TECHNIQUE

Preoperative Planning

Detailed preoperative planning is critical to proper deformity correction. The information garnered can be used to identify the underlying pathology as well as the origin and cause of the deformity. As part of the preoperative planning process, a thorough patient history and clinical examination should be conducted. The patient's pain, sensory deficits, and ambulatory status should be taken into consideration. The clinical examination should include both a static evaluation of foot position and a dynamic evaluation with gait analysis. Tools are available to enhance the study of patient biomechanics (1).

Muscle strength of the tibialis anterior must be accurately quantified. An initial strength of 4 or greater is required to retain functionality, as one grade of muscle strength is typically lost following tendon transfer. Weight-bearing lateral and anteroposterior radiographs of the foot and ankle should be obtained. In cases of severe deformity, additional studies, such as magnetic resonance imaging or computed tomography, may be necessary to evaluate the deformity fully. These imaging modalities will allow the surgeon to identify any superimposed bony deformities that may require correction during the index procedure (8).

Kuo et al. (9) suggest that the most appropriate point of fixation is the lateral cuneiform in the full tendon transfer and the cuboid bone in the split tendon transfer. This is not a hard-and-fast guideline, because selection of the anchoring bone is based on clinical evaluation, particularly the strength of the peroneals and the amount of correction necessary to balance the foot. The greater the correction, the more laterally the fixation must be placed.

As stated by Lampasi et al. (10) "in feet with a rigid or partially correctable deformity, transfer of the (tibialis anterior tendon) should not be expected to provide much improvement, except for reduction of adduction in more flexible feet, and correction should be provided by other procedures." For this reason, the transfer of the tibialis anterior tendon is rarely performed in isolation. Most commonly, a gastrocnemius recession is required to address equinus deformity. If spasticity of the posterior tibial tendon exists, a myotendinous lengthening may be necessary to reduce associated heel varus. Fixed deformities may require calcaneal osteotomy, subtalar or triple arthrodesis, extensor tendon lengthening, or tenotomies for digital correction. These procedures should always be considered during the preoperative evaluation (11).

Despite an over whelming acceptance of the procedure, there is no defined temporal indication. It is generally agreed that transfer of the tendon alone or with a gastrocnemius recession may be more effective in children, whereas bony procedures are often required in older patients. In any event, a comprehensive operative approach is needed, tailored specifically to the deformity and the patient (1).

Preparation and Patient Positioning

Patient positioning must permit exposure to the medial foot, lateral foot, and anterior leg. Therefore, the patient should be supine with an ipsilateral bump to position the leg rectus with the tibial tuberosity forward. A combination of general and regional anesthesia is preferred, but spinal anesthesia can also be used. A pneumatic thigh tourniquet is insufflated after exsanguination of the lower leg (1).

Operative Approach

A 3-incision approach is used for both the tibialis anterior tendon transfer and the STATT, with incision placement as follows (Fig. 1) (1):

Dorsal–medially on the foot overlying the tibialis anterior tendon insertion at the medial side of the medial cuneiform and base of the first metatarsal.

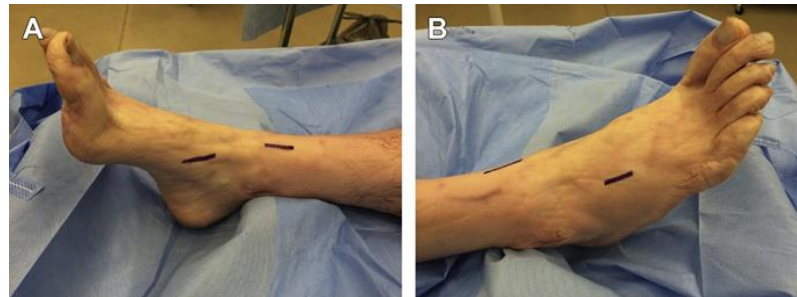


Figure 1. Incision placement for transfer of the tibialis anterior tendon. Incisions 1 and 2 provide exposure to the tendon (A), whereas incision 3, located laterally on the dorsal aspect of the foot, represents the point of tendon stabilization (B). The technique shown provides stabilization through fixation into the lateral cuneiform (1).

Operative Procedure

Tibialis anterior tendon transfer

The sheath is incised in a linear fashion (incision 1; (Fig. 2)). The tendon is identified and sharply released from its insertion. Through the incision on the anterior leg (incision 2), the tibialis anterior tendon is identified and gently pulled proximally along its sheath through the incision. The end of the tendon is “tagged” with a suture in a whip- stitch fashion. A tendon passer is inserted through the dorsal-lateral foot incision (incision 3), and retrieved through the anterior leg (incision 2). Care must be taken to ensure that the tendon passer remains within the long extensor sheath, underneath the extensor retinaculum. The tendon is retrieved and delivered through the dorsal–lateral foot incision. The tendon is then secured to the lateral cuneiform or the cuboid to appropriately balance the foot. Two methods of fixation exist (1).

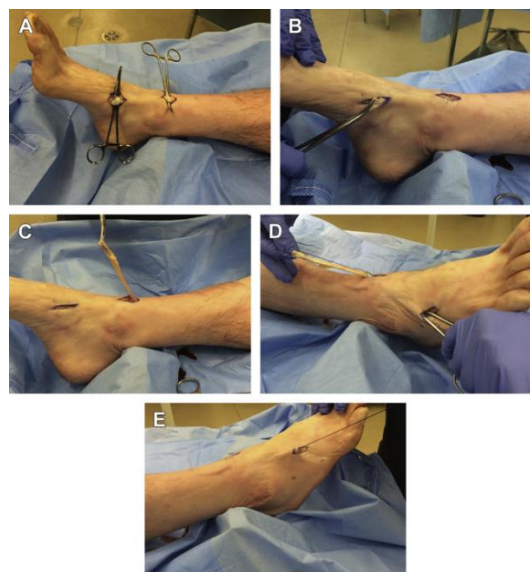


Figure 2. Complete tibialis anterior tendon transfer. The tendon is identified and isolated through incisions 1 and 2 (A). The tendon is released completely from its insertion point through incision 1 (B) and drawn out through the anterior lower leg incision (incision 2; C). The end of the tendon is whip stitched and retrieved with the use of a hemostat from incision 3 underneath the extensor retinaculum (D, E) (1).

- **Interference screw (Fig. 3):** A guidewire is placed from dorsal to plantar through the anchoring bone and retrieved through the plantar aspect of the foot. The tendon is sized, and the appropriate reamer for the interference screw is used over the previously placed guidewire. The tendon is passed through the prepared canal and out the plantar aspect of the foot. The foot is held in neutral dorsiflexion with slight eversion while appropriate physiologic tension is placed on the tendon. The interference screw is advanced from dorsal to plantar, securing the tendon. The suture is cut flush with the plantar aspect of the foot.
- **Tendon anchor (Fig. 4):** A tendon anchor of the surgeon's choice is placed from dorsal to plantar into the anchoring bone. The suture attached to the anchor is used to secure the tendon to the bone using a suture technique of the surgeon's choice. Excess tendon must be trimmed before suturing. To ensure that the appropriate amount of tendon is trimmed, the foot is held in neutral dorsiflexion with slight eversion, appropriate physiologic tension is placed on the tendon, and the tendon is trimmed accordingly.

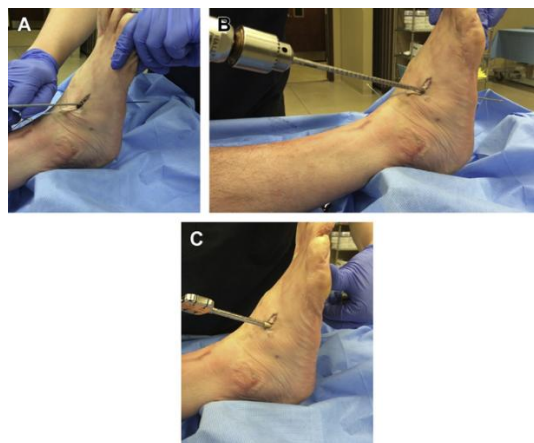


Figure 3. Stabilization of the tendon with an interference screw. A guidewire for the appropriate sized interference screw is placed from dorsal to plantar through the anchoring bone exiting the plantar foot (A). This technique shows stabilization into the lateral cuneiform. The corresponding reamer is used over the guidewire (B), and the tendon is passed through the prepared hole exiting the plantar foot. With the foot dorsiflexed and slightly everted, the tendon is appropriately tensioned and the interference screw is advanced from dorsal to plantar, securing the tendon into the cuneiform (C) (1).

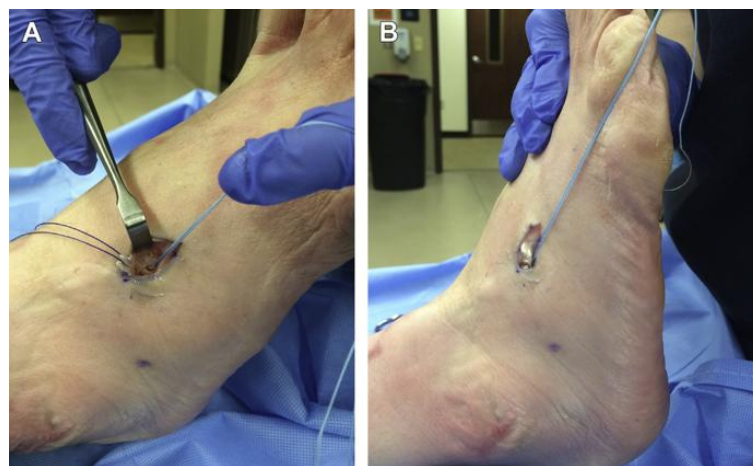


Figure 4. Stabilization of the tendon with an anchor. An appropriately sized tendon anchor is inserted into the anchoring bone from dorsal to plantar (A). This technique shows stabilization into the lateral cuneiform. After the tendon is trimmed appropriately, the suture from the anchor is used to secure the tendon to the bone (B). The foot is held in dorsiflexion with slight eversion and appropriate tension is placed on the tendon (1).

REHABILITATION AND RECOVERY

Non-weight-bearing begins immediately after surgery. A postoperative splint is applied to maintain the desired foot position and adjusted accordingly over the course of 6 weeks. The patient is then graduated to a controlled ankle motion boot with progressive weight bearing. At this juncture, rehabilitation is initiated. Therapy focuses on tibialis anterior muscle retraining, gait training, and progressive strengthening. The in-phase transfer of the tibialis anterior is beneficial to recovery, because the original function of the tendon is preserved and functional gains can be more rapidly achieved. Return to full activity depends on functional improvements with rehabilitation. Complete functional recovery is typically achieved within three to five months. The rehabilitation course should be altered in accordance with the performance of concomitant procedures. If non-weight-bearing is anticipated beyond six weeks, it is still recommended that the patient begin physical therapy with active, open chain motion, and muscle training (12).

COMPLICATIONS

Morbidity associated with this procedure is relatively low; however, complications can occur. [Table 1](#) provides a list of potential complications.

CLINICAL RESULTS IN THE LITERATURE

Tibialis anterior tendon transfers are used to address soft tissue imbalances and instabilities. With nonreducible deformities, however, bony procedures are often needed to address the structural abnormalities. Consequently, the procedure is often tailored specifically to the deformity and the patient. Further complicating the interpretation of the results, numerous variations of the tibialis anterior tendon transfer have been reported since its initial introduction. Surgeons have described subcutaneous transfer of the tibialis anterior, transfer through a 2-incision approach, transfer through a 3-incision approach, and split transfer. The tendon can be rerouted above or below the extensor retinaculum with variable sites of fixation and methods of fixation (13).

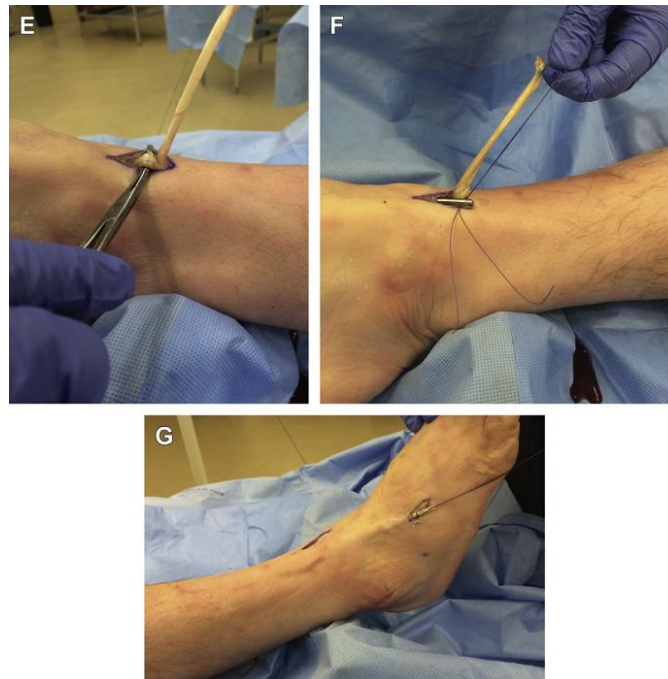


Figure 5. Preparation of tibialis anterior tendon and transfer to lateral cuneiform (1).

Table 1: Complications associated with tibialis anterior tendon transfer (1).

Complication	Iatrogenic Factors
Infection	Transfer of the tendon too far laterally or use of a split
Overcorrection	transfer over a full transfer
Undercorrection	Inappropriate or absence of necessary concomitant procedures
Instability	Unopposed extensor hallucis longus and peroneus longus
Muscle necrosis	
Rupture of tendon transfer	
Damage to neurovascular	
Structures	
Transient tenosynovitis	
Cocked-up hallux	

Given the similar indications for the transfer of the tibialis anterior, the complete and split procedures are often used for the management of the same or similar conditions, both providing consistent results. Even so, the two procedures are often examined separately. **Thompson et al. (14)** sought to determine whether subcutaneous tibialis anterior tendon transfer effectively treats recurrent clubfoot and whether the presence of structural deformities influenced the outcomes. Using a subjective rating system, the study confirmed that the tibialis anterior tendon transfer effectively restores muscle balance in recurrent clubfeet with resultant improvements in function. Balance was restored in 87% to 88% of patients with data to suggest that the tibialis anterior tendon transfer may prevent secondary osseous alteration (14).

Gray et al. (15) conducted a prospective, comparative study to evaluate the effectiveness of the tibialis anterior tendon transfer at restoring the balance between eversion and inversion strength. The treatment group consisted of children with idiopathic congenital talipes equinovarus indicated for tibialis anterior tendon transfer, and the control group consisted of age-matched children with congenital talipes equinovarus who, after Ponseti casting, were not eligible for tibialis anterior tendon transfer. The study found that the tibialis anterior tendon transfer procedure effectively restored the inversion to eversion balance one year after surgery. Furthermore, the treatment group demonstrated similar plantar loading, function, and satisfaction outcomes compared with the control group (15).

References:

1. Mulhern JL, Protzman NM, Brigido SA. Tibialis anterior tendon transfer. Clinics in Podiatric Medicine and Surgery. 2016 Jan 1;33(1):41-53.
2. Garceau GJ. Anterior tibial tendon transposition in recurrent congenital club- foot. J Bone Joint Surg Am 1940;22:932–6. Available at: <http://jbjs.org/content/22/4/932>.
3. Ponseti IV, Campos J. The classic: observations on pathogenesis and treatment of congenital clubfoot. 1972. Clin Orthop Relat Res 2009;467:1124–32. Available at: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2664437/>.
4. Sarıkaya İA, Bırsel SE, Şeker A, Erdal OA, Görgün B, İnan M. The split transfer of tibialis anterior tendon to peroneus tertius tendon for equinovarus foot in children with cerebral palsy. Acta Orthopaedica et Traumatologica Turcica, 2020; 54(3), 262.
5. Jerome, J. T. J., & Karunanithi, D. (2024). Extensor tendon reconstruction in vaughan–jackson syndrome: surgical technique and a case illustration. Apollo Medicine, 21(4), 401-408.

6. Moreira, A., Benjamin Ravetti, L., Carrapeiro Prina, D., & Paschoal Nogueira, M. (2024). Anterior tibial tendon transfer in idiopathic clubfoot: pull-out vs. other fixations—a systematic review. *BMC musculoskeletal disorders*, 25(1), 638.
7. Özyalvaç, O. N., Kirat, A., Akpınar, E., Dinçel, Y. M., Özkul, B., & Bayhan, A. İ. (2019). The Effect of Tibialis Anterior Tendon Transfer on Metatarsus Adductus Deformity in Children with Clubfoot. *Istanbul Medical Journal*.
8. Eisenstein, N., Fischer, B., & Nayagam, S. (2023). Tibialis posterior tendon transfer for the management of foot drop. *Strategies in Trauma and Limb Reconstruction*, 18(1), 56.
9. Kuo KN, Hennigan SP, Hastings ME. Anterior tibial tendon transfer in residual dynamic clubfoot deformity. *J Pediatr Orthop* 2001;21:35–41. Available at: http://journals.lww.com/pedorthopaedics/Abstract/2001/01000/Anterior_Tibial_Tendon_Transfer_in_Residual.9.aspx.
10. Lampasi M, Bettuzzi C, Palmonari M, et al. Transfer of the tendon of tibialis anterior in relapsed congenital clubfoot: long-term results in 38 feet. *J Bone Joint Surg Br* 2010;92:277–83. Available at: <http://www.bjj.boneandjoint.org.uk/content/92-B/2/277.long>.
11. Keenan MA. The management of spastic equinovarus deformity following stroke and head injury. *Foot Ankle Clin* 2011;16:499–514. Available at: <http://www.sciencedirect.com/science/article/pii/S1083751511000532>.
12. Júnior AR, Generoso TO, Braga SR, Pegoraro M, Blumetti FC. Anterior tibial tendon transfer: a novel surgical proposal. *Journal of the Foot & Ankle*. 2023 Dec 22;17(3):196-200.
13. Knutsen AR, Avoian T, Sangiorgio SN, et al. How do different anterior tibial tendon transfer techniques influence forefoot and hindfoot motion? *Clin Orthop Relat Res* 2015;473:1737–43. Available at: <http://link.springer.com/article/10.1007%2Fs11999-014-4057-0>.
14. Thompson GH, Hoyer HA, Barthel T. Tibialis anterior tendon transfer after clubfoot surgery. *Clin Orthop Relat Res* 2009;467:1306–13. Available at: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2664443/>.
15. Gray K, Burns J, Little D, et al. Is tibialis anterior tendon transfer effective for recurrent clubfoot? *Clin Orthop Relat Res* 2014;472:750–8. Available at: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3890208/>.