Tibialis Anterior Tendon Transfer for Posterior Tibial Tendon Insufficiency.

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KEYWORDS

• Tibialis anterior tendon • Flatfoot • Posterior tibial tendon dysfunction • Cobb • Calcaneal osteotomy • Surgery

KEY POINTS

- The Cobb procedure is useful for addressing stage 2 posterior tibial tendon dysfunction.
- The Cobb procedure is usually accompanied by a medial displacement calcaneal osteotomy and/or lateral column lengthening.
- The Cobb procedure can also be combined with selected medial column arthrodesis and realignment osteotomies along with equinus correction when indicated.

INTRODUCTION

The role of posterior tibial tendon (PTT) dysfunction (PTTD) as a cause of adult-acquired flatfoot is well established. Johnson and Strom's[1] classification of PTTD separated the flexible from the rigid deformities and provided recommended surgical treatments for each stage. In the early stages of PTTD (stage 1 and stage 2), when the condition is flexible, soft tissue reconstructive procedures can be used to achieve pain relief and prevent progression to rigid deformity. Stage 2 PTTD encompasses a wide range of clinical manifestations; therefore, several surgical procedures have been proposed for correction of an insufficient or elongated PTT in combination with a supple hindfoot valgus after failed nonoperative management. To date, the most commonly reported procedures used to correct stage 2 PTTD are the flexor digitorum longus

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tendon (FDLT) transfer in combination with medial displacement calcaneal osteotomy (MDCO) and/or lengthening of the lateral column. Although these techniques may correct the loss of the medial arch and forefoot abduction, supination deformity of the forefoot is not addressed; this can become more problematic for patients with correction of the hindfoot.[2] In addition, alternative transfer using the tibialis anterior tendon (TAT) has been proposed to avoid sacrificing the FDLT because it plays such a key role in the biomechanical function of the foot.[3]

HISTORICAL PERSPECTIVE

In 1923, Lowman[4] reported the use of the TAT as a sling under the navicular to restore the medial arch in symptomatic flatfeet. In the late 1970s, Cobb[5] described a technique for stage 2 PTTD using a split tibialis anterior musculotendinous graft to reconstruct the PTT, restore plantar flexion function of the first ray, and correct forefoot supination. The original Cobb procedure included first a medial incision to expose the damaged PTT for resection and then a second incision over the anterior muscle compartment proximal to the ankle for splitting of the TAT. The anterior half of the anterior tendon is then passed distally in its sheath and through a drill hole in the medial cuneiform into the PTT sheath across the site of the PTT deficit and then secured at the plantar surface of the naviculocuneiform (NC) joint with the healthy proximal portion of the PTT. Since its inception, the Cobb procedure, with certain modifications, has been described by Helal, Benton-Weil and Weil, and Janis and colleagues.[6–8] Each of these investigators provided overviews of their modifications in a small number of patients. Since then, several larger series have been published on the outcomes of the TAT transfer in combination with other corrective procedures for the treatment of symptomatic stage 2 PTTD, which provide more detailed information and longer follow-up (**Table 1**).

INDICATIONS

The Cobb procedure is mostly used for stage 2 PTTD. The acquired flatfoot deformity must be flexible and corrected at the time of the Cobb procedure. Often, an MDCO is performed to address the calcaneal valgus and to realign the weight-bearing axis of the heel with the tibia. In addition, if significant midfoot/forefoot abduction is present, it may be addressed with lateral column lengthening. At times, compensatory forefoot varus may be present; if not addressed, it can lead to destabilization of the medial column and recurrent rear foot deformity. Forefoot varus is best approached with a first tarsometatarsal (TMT) arthrodesis as opposed to a Cotton opening wedge osteotomy with bone grafting when a Cobb procedure is performed. The inherent stability of the TMT arthrodesis corrects the forefoot varus while providing additional stability to the medial longitudinal arch. In addition, a drill hole can still be placed through the medial cuneiform for passage of the split portion of the TAT if desired. Gastrocnemius recession or percutaneous tendo-Achilles lengthening in the presence of equinus may also need to be corrected before any realignment procedures. Significant advantages of the Cobb procedure are that tendon function is not sacrificed and it provides a suspensory effect to the medial column of the foot. In select cases, the Cobb procedure can be used to reconstruct the spring ligament in conjunction with an FDLT transfer (**Fig. 1**).

COBB TECHNIQUE

An approximately 3-cm incision is placed over the proximal anterolateral portion of the TAT. The retinaculum is released; the medial half portion of the TAT is identified, split,

Table 1
Case series involving Cobb procedure for stage 2 PTTD

Authors, Year	N	Age Range	Adjunct Procedures	Average Follow-up	Postoperative Outcome	Complications
Giorgini et al,[9] 2010	50 Feet in 39 patients	5–70 y	Kidner procedure (resection of accessory navicular and/or prominent navicular tuberosity with advancement of PTT insertion)	4.6 y	48 Good (no pain, unlimited activity, no difficulty with shoe fit) 2 Fair (occasional pain, limit on strenuous activity, minor difficulty with shoe fit)	1 Wound dehiscence 1 Fractured hardware
Parsons et al,[10] 2010	32 Feet in 32 patients	44–66 y	Medial displacement translational osteotomy of calcaneus	5.1 y	Mean AOFAS hindfoot score of 89 29 Were able to perform single-heel rise test (none before surgery) at 12 mo and final follow-up All preferred to wear comfort insoles in normal footwear	1 Superficial wound dehiscence 1 Temporary dysesthesia of medial plantar nerve
Madhav et al,[11] 2009	43 Feet in 43 patients	27–75 y	Rose calcaneal osteotomy (transverse osteotomy with excision of medially based one-half width wedge of bone)	4.28 y	Mean AOFAS hindfoot score of 85 66% Were able to perform single-heel rise test 78% Were able to use normal footwear 65% No longer required orthotics	1 Saphenous nerve injury 1 Sural nerve injury 4 Cases of oozing from wounds 2 Developed subtalar joint osteoarthritis 6 Cases required screw removal for local irritation

(*continued on next page*)

Table 1
(*continued*)

Authors, Year	N	Age Range	Adjunct Procedures	Average Follow-up	Postoperative Outcome	Complications
Knupp & Hintermann,[2] 2007	22 Feet in 22 patients	29–64 y	Deltoid ligament reconstruction (17 patients) Spring ligament repair (3 patients) Medial sliding calcaneal osteotomy (11 patients) Calcaneal lengthening osteotomy (3 patients)	2.0 y	Mean AOFAS hindfoot score of 88.5 86% Were able to wear shows without modifications or orthotics 14% Preferred to have orthotic inlays	1 Skin necrosis 1 Loss of sensation at the medial aspect of the midfoot 2 Patients had revision surgery because of pain (1 triple arthrodesis and 1 screw removal)
Weil et al,[12] 1998	13 Feet in 13 patients	53–80 y for stage 2 PTTD and 41–73 y for stage 3 PTTD	Cobb reconstruction alone in stage 2 PTTD (5 patients) Evans lateral column lengthening (8 patients)	1.0 y–5.25 y	Patients with stage 2 PTTD had a better satisfaction than patients with stage 3	1 Patient in stage 2 PTTD did not meet expectations. and half of the patients in stage 3 PTTD did not meet expectations

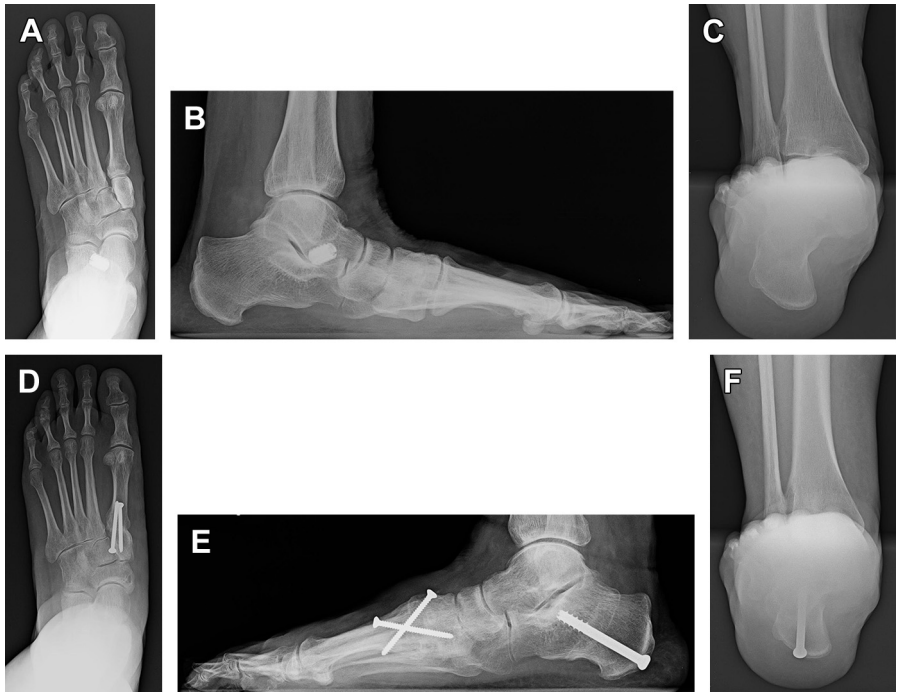

Fig. 1. Preoperative anteroposterior (*A*), lateral (*B*), and calcaneal axial (*C*) views of a previous multiple surgical reconstructions of the PTT with synovectomy, tendon allografting, and subtalar joint arthroereisis. Patient underwent revision reconstructive surgery with removal of the subtalar joint implant, MDCO, lateral column lengthening, first TMT joint arthrodesis, FDLT transfer, and Cobb procedure. Final postoperative radiographs (*D–F*) at 1-year follow-up.

and kept in place by an umbilical tape while maintaining its insertion on the medial cuneiform. A large curved hemostat or tendon passer is then introduced from distal to proximal orientation and under the TAT sheath to exit at the proximal leg incision. The umbilical tape is then introduced to the tendon passer and exits distally at the insertion of the TAT to the medial cuneiform. At that time the TAT can be split, and after it is released proximally. The harvested portion of the TAT can then be passed under the periosteum or through a drill hole in the medial cuneiform. A transfer and tenodesis of the split portion of the TAT is then performed with the remaining portion of the PTT after it was debrided. The tenodesis should be performed with the foot held in a plantar-flexed and inverted position. The Cobb procedure can also be combined with an FDLT transfer when the posterior tibialis muscle excursion is compromised and the spring ligament is attenuated. It is also preferable to perform the Cobb procedure after all osteotomies and selected arthrodesis sites have been completed (Fig. 2).

ADJUNCTIVE PROCEDURES

Medial Displacement Calcaneal Osteotomy

MDCO is performed to correct the hindfoot valgus deformity, assist in medialization of the Achilles tendon, and to reestablish the weight-bearing hindfoot alignment axis of the calcaneus with the tibia. The MDCO aligns the foot into a more mechanically advantageous position, thus offsetting the load on the tendon transfer. The osteotomy is

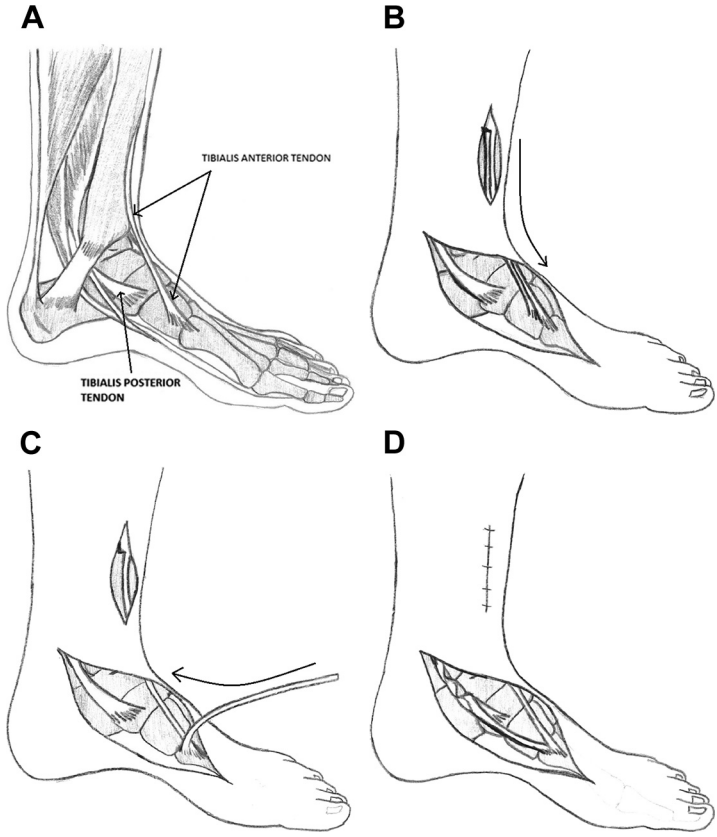

Fig. 2. Tendon and osseous anatomy with location of the TAT and PTT (*A*). Incision placements for access to pathologic PTT for debridement and for harvesting of split medial half of the TAT with arrow depicting direction of tendon separation (*B*). Arrow depicts direction of rerouting the split TAT graft along its tendon sheath to its most distal attachment at the medial cuneiform and base of the first metatarsal (*C*). The TAT graft placed through a drill hole into the medial cuneiform and then with the foot placed in plantar flexion and inversion; the tendon graft is then weaved through and attached to the distal end of the PTT (*D*).

performed through a direct 4- to 5-cm oblique incision located posterior and inferior to the peroneal tendons and course of the sural nerve. Blunt dissection is taken down to the lateral calcaneal wall, and an oblique osteotomy is performed with an oscillating saw with caution to avoid overpenetrating the medial calcaneal wall. The osteotomy is distracted with lamina spreaders stretching the medial periosteum to allow for displacement. The osteotomy is then translated medially approximately 1 cm or based on the alignment desired. Distal translation can be performed to increase the calcaneal pitch. The osteotomy can be secured with a single 6.5-mm cannulated screw or other various methods of fixation.

Lateral Column Lengthening

The main goal of the lateral column lengthening is to correct abduction of the midfoot and forefoot. This procedure can provide triplane correction of an acquired flatfoot deformity by the mechanical advantage of the peroneal longus to correct forefoot

varus resulting in compensatory varus position of the calcaneus. The lateral column lengthening is often combined with an MDCO. The double osteotomy allows correction of acquired hindfoot valgus and forefoot/midfoot abduction deformity. A 3-cm longitudinal incision is made directly over the floor of the sinus tarsi and anterior process of the calcaneus. The sural nerve and the peroneal tendons are identified and retracted accordingly. A sagittal saw is used to create an osteotomy approximately 1.5 cm proximal to the calcaneocuboid joint. The osteotomy is distracted, and a piece of tricortical bone graft is used to achieve the lengthening. This osteotomy may or may not be secured with any type of fixation.

First Tarsometatarsal Arthrodesis

When medial column stabilization and/or correction of forefoot varus are required in conjunction with a Cobb procedure, it is advantageous to include an arthrodesis of the first TMT joint. Indications for a first TMT include significant forefoot varus, abnormal lateral talo-first metatarsal angle on weight-bearing lateral radiographs, TMT joint arthrosis, first metatarsal elevatus, and/or hypermobility of the medial column. In addition the incision over the first TMT joint allows exposure of the distal TAT. The first TMT joint is exposed through a 5-cm incision fashioned just medial to the extensor hallucis longus tendon over the TMT joint. Meticulous joint preparation

Fig. 3. Preoperative anteroposterior (*A*) and lateral (*B*) views of a stage 2 PTTD that underwent a combined Cobb procedure with a naviculocuneiform arthrodesis. Final postoperative radiographs (*C*, *D*) at approximately 1-year follow-up.

is required to avoid nonunion. The first metatarsal is plantar flexed, and fixation is generally performed with dual-compression lag screws.

Naviculocuneiform Arthrodesis

In certain cases, whereby medial column stabilization is required in conjunction with the Cobb procedure, an NC arthrodesis may be performed in the presence of NC joint arthrosis, instability, and sagging. The surgical incision also provides exposure of the distal portion of the TAT for the Cobb procedure, and arthrodesis is achieved with compression lag screws (**Fig. 3**).

SUMMARY

The Cobb procedure may be considered for stage 2 PTTD in conjunction with realignment osteotomies and/or selected medial column stabilization arthrodesis procedures. Although retrospective in nature, the collective findings of the studies in **Table 1** demonstrate that the Cobb procedure is a useful technique to decrease pain and improve function for stage 2 PTTD. Although it is difficult to analyze the effects of the adjunct procedures performed in the aforementioned studies, a randomized control trial that directly compares the Cobb procedure plus MDCO with the FDLT transfer plus MDCO would be beneficial.

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