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Technical Tips

Anterior tibial tendon transfer: a novel surgical proposal

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Abstract

Congenital equinovarus clubfoot is one of the most common congenital musculoskeletal deformities, and the treatment described by Ponseti is considered the gold standard; however, the recurrence rate can be significant. In cases of failed conservative treatment and persistent dynamic forefoot adduction and supination deformities, transfer of the anterior tibial tendon to the dorsolateral region of the foot may be indicated. In this paper, we present a novel surgical technique involving a double passage of the tendon through osseous tunnels and final fixation of the transferred tendon onto itself, ensuring optimal fixation and cost-effectiveness while mitigating complications associated with the conventional method. We advocate for adopting this novel technique as a treatment method for dynamic deformities resistant to non-surgical interventions for congenital clubfoot.

Level of Evidence V; Therapeutic Studies; Expert Opinion.

Keywords: Ankle joint; Clubfoot; Tendon transfer.

Introduction

Congenital equinovarus clubfoot is one of the most common congenital musculoskeletal deformities, and the treatment approach utilizing repeated manipulations and serial casting, as described by Ponseti, is considered the optimal strategy for addressing this condition. However, the recurrence rate can range from one-third to 52% of cases[1,2]. In such instances, a recurrent attempt at correction is typically pursued using the same serial casting technique; in some cases, surgical interventions involving soft tissue releases, tendon transfers, or osteotomies are employed to achieve pain-free and plantigrade feet. Despite successfully correcting the peri-talar complex in certain scenarios, dynamic deformity involving forefoot adduction and supination may persist. In such cases, transfer of the anterior tibial tendon to the dorsolateral region of the foot may be indicated.

Originally described by Garceau[3] in 1940, the anterior tibial tendon transfer technique has evolved over the years as clinical practice and patient follow-up have allowed the assessment of outcomes and complications associated with this procedure. Among the techniques described and employed thus far, some involve the use of implant materials such as anchors or screws for fixation of the transplanted tendon. In contrast, others present complications when anchoring to the plantar skin using buttons.

Given this context, the authors in this study have conceived a new surgical technique detailed herein for anterior tibial tendon transfer. This method involves passing the tendon through osseous tunnels and securing the transferred tendon onto itself, ensuring optimal efficacy and cost-effectiveness.

Surgical technique

With a pneumatic tourniquet inflated on the thigh, the detachment of the anterior tibial tendon from the medial aspect of the foot is performed through an anteromedial skin incision. It is crucial to preserve maximum tendon length by mobilizing its entire insertion. A thorough dissection of the tendon is important, as there might be expansions at its insertion site (Figure 1A).

Study performed at the Hospital Israelita Albert Einstein, São Paulo, SP, Brazil.

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The tendon is secured with a Krakow-type suture using absorbable Vycril thread, either size 0 or 1, ensuring at least 20 cm of suture thread remains beyond the tendon's end. Proximal dissection of the tendon extends to the ankle retinaculum, with the release of any vincula if present (Figure 1B).

A second 2 cm longitudinal incision is made on the dorsum of the midfoot, aligned with the third metatarsal, to expose the midfoot capsules. Care is taken to mobilize the short extensor muscle of the toes and its tendons.

The anterior tibial tendon is transferred from the medial to the dorsal incision through a subcutaneous passage between the two incisions. The tendon should easily slide laterally to its new position. The ankle retinaculum offers ample space for tendon gliding, allowing it to remain straight up to the point of the new insertion. Any residual bands of scar tissue or vincula should be released (Figure 1C).

A capsule and perichondrium or periosteum flap are fashioned to expose the midfoot joints, enabling inspection of the midfoot joints, which must be avoided when creating the incisions to pass the transplanted tendon (Figure 2).

A large incision, typically around 4 mm in diameter, is vertically drilled into the lateral cuneiform, and a second incision of the same diameter is created in the cuboid or intermediate cuneiform, depending on the surgeon's preference for the most suitable location to accommodate the transplanted tendon. These incisions should ideally be the same diameter as the tendon (Figure 3).

A perforated guide wire, with the ends of the suture thread attached, is passed through the osseous tunnel from the dorsal to the plantar, directed medially to prevent neurovascular structure injury. A small incision of approximately 5 mm is made on the plantar region to exteriorize this guide wire (Figure 4).

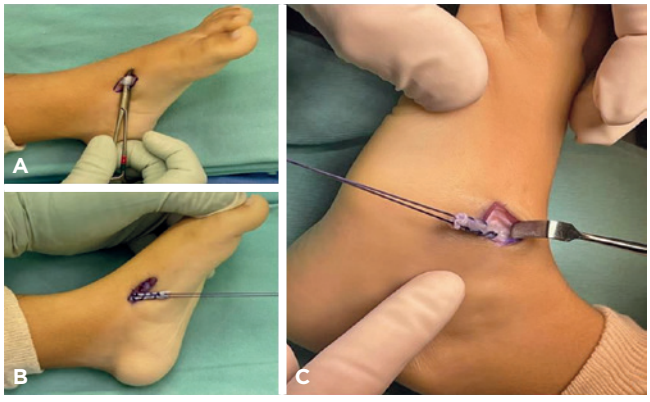


Figure 1. A) Dissection and detachment of the anterior tibial tendon from the medial aspect of the foot; B) The tendon is secured with a Krakow-type suture; C) Anterior tibial tendon is transferred from the medial incision to the dorsal incision.

Figure 2. A capsule and perichondrium or periosteum flap are fashioned.

Figure 3. A incision is vertically drilled into the lateral cuneiform.

Through this incision, soft tissues of the plantar region are dissected to the plantar bony surface of the lateral cuneiform. Using the same incision, a cannula with approximately 5 mm is introduced through the guide wire to the plantar bony surface. The passage of the guide wire through the cannula is completed, guiding the suture thread to be exteriorized through the skin while ensuring the cannula maintains its snug osseous position (Figures 5 and 6).

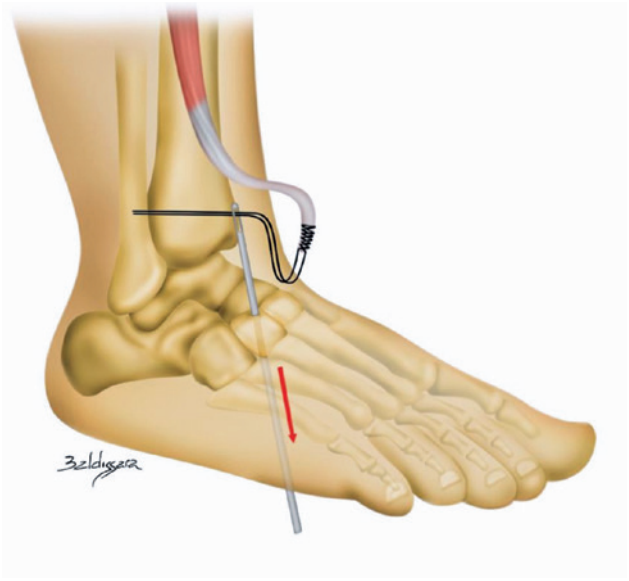


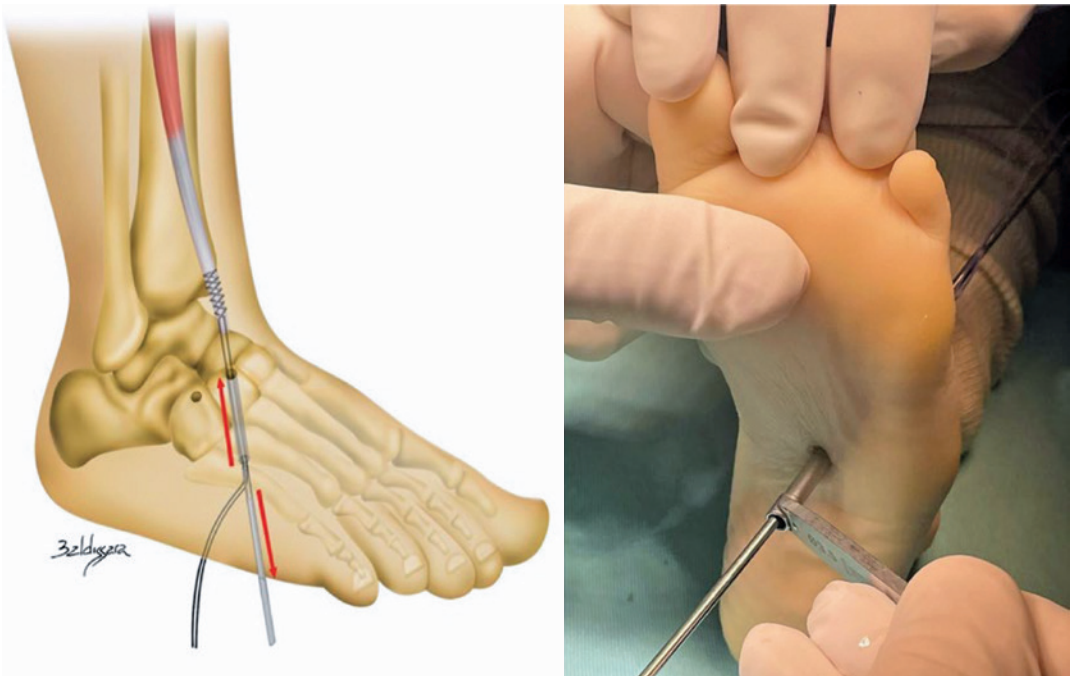
Figure 4. A guide wire, with the ends of the suture thread attached, is passed through the osseous tunnel from the dorsal to the plantar.

The guide wire, which was retracted, is then inserted through the second bone incision, from the dorsal to the plantar, but now with the incisions facing the plantar surface. The cannula is slid laterally, maintaining bony contact until it meets the inserted guide wire in the second incision, allowing the guide wire to be fully passed through the cannula (Figure 7).

The ends of the suture thread are then attached to the guide wire, and at this point, traction is applied by tensioning the tendon in the first incision. With the tendon maintained in position, noting that the child's foot should be in dorsiflexion and slight eversion, the guide wire is pulled from the plantar to the dorsal, thus exteriorizing the suture thread ends dorsally (Figures 8 and 9), forming a loop around the two perforated incisions (Figure 10).

With traction on the suture threads and the tendon introduced through the first incision, the desired tension is calibrated, and dorsal suturing of the threads onto the tendon itself is performed. The flap of the capsule and periosteum is also sutured over the tendon (Figures 11 and 12).

Postoperative management follows standard protocols, including suropodalic cast immobilization in 10-degree dorsiflexion and slight foot eversion, to be maintained for six weeks. Weight-bearing is allowed after four weeks post-surgery.



Figures 5 and 6. Plantar soft tissue dissection and passage of the guide wire through a cannula to exteriorize the suture thread through the plantar skin.

Discussion

The anterior tibial tendon transfer to the dorsolateral region of the foot aligned with the axis of the third metatarsal[4], indicated for persistent dynamic deformities refractory to conservative treatment, is employed in 15%–40% of cases of congenital clubfoot[5], effectively addressing dynamic forefoot supination[6,7].

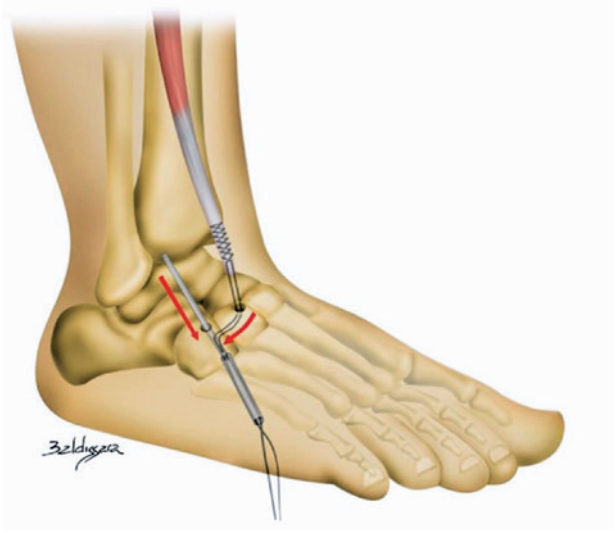


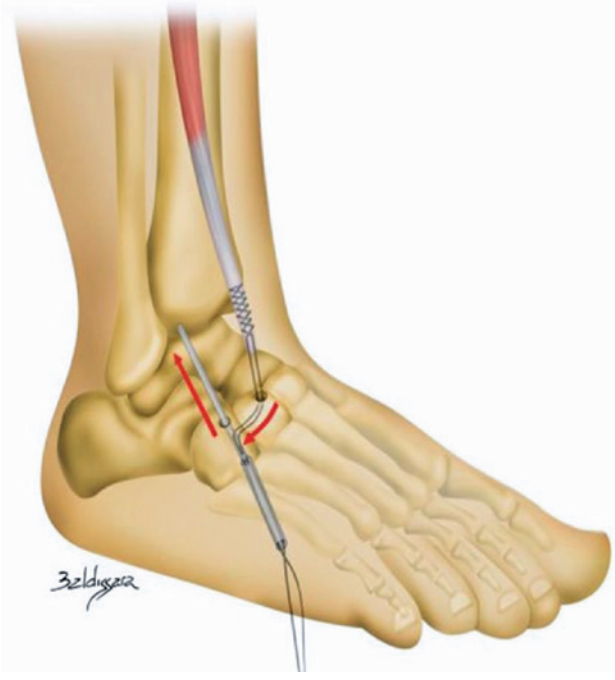
Figure 7. The guide wire is inserted through the second bone incision, from the dorsal to the plantar, with the incisions facing the plantar surface until it is passed through the cannula to protect the soft tissues.

The most commonly used technique to execute this procedure involves passing the tendon through an osseous tunnel in the lateral cuneiform and threading and anchoring the suture threads through the plantar surface of the foot[8]. This method may entail potential complications such as skin necrosis, vascular injury, and tension loss in the transplanted tendon. Other technical possibilities have also been described, including biotenodesis screws, suture buttons, and anchor fixation[2,9].

Radiographic and histological outcomes obtained using different methods of fixation for the transferred anterior tibial tendon in immature porcine skeletons were compared by Korth et al.[10], demonstrating superior results for fixation performed through osseous tunnels and bone sutures and poorer results for cases fixed with suture anchors.

The technique presented involves the double passage of the transferred tendon through osseous tunnels, combined with the final suturing of the tendon onto itself, ensuring excellent fixation. Furthermore, it does not need specific materials, making it financially economical. By avoiding plantar "pull out," this technique circumvents potential complications occasionally observed with the traditional method, particularly tendon tension loss and skin necrosis.

In our institution, this technique has been utilized for treating cases of congenital clubfoot with dynamic defor-



Figures 8 and 9. The guide wire is pulled from the plantar to the dorsal, thus exteriorizing the suture thread ends dorsally.

mities involving forefoot supination and adduction, yielding satisfactory outcomes.

The surgical technique detailed here for anterior tibial tendon transfer, utilizing a double passage of the tendon through osseous tunnels and final fixation of the transferred tendon onto itself, ensures excellent fixation and cost-effectiveness while mitigating complications associated with the conventional method. We advocate for adopting this novel technique as a treatment method for dynamic deformities resistant to conservative interventions for congenital clubfoot.

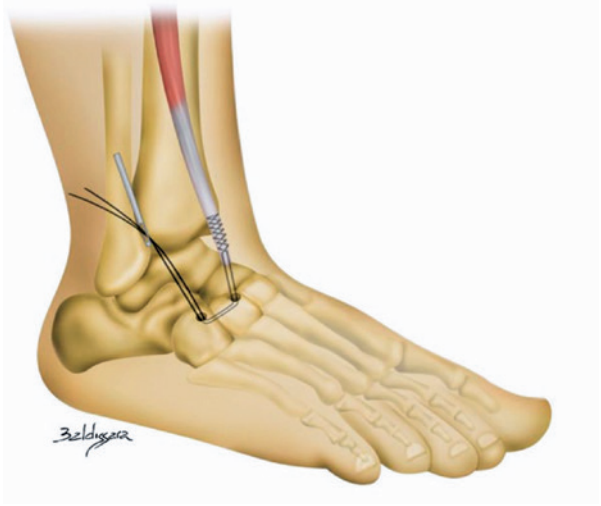
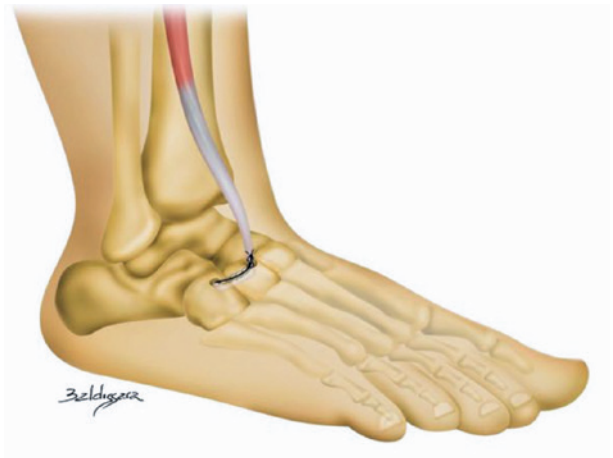
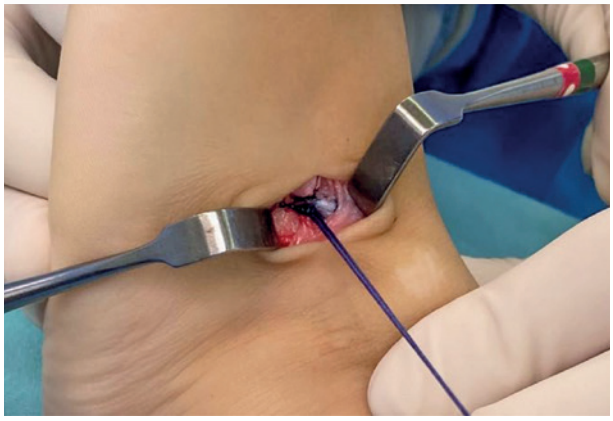


Figure 10. A loop is formed with the suture thread around the two perforated bones.





Figures 11 and 12. Suturing of the threads onto the transferred tendon.

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