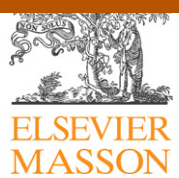
Orthopaedics & Traumatology: Surgery & Research (2012) **98**, 829—833



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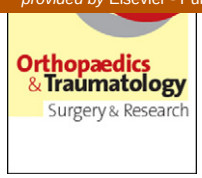

TECHNICAL NOTE

Fixation of split anterior tibialis tendon transfer by anchorage to the base of the 5th metatarsal bone

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Accepted: 2 July 2012

KEYWORDS
Achilles tendon/surgery;
Foot deformity;
Acquired/surgery;
Suture anchor;
Tendon transfer;
Hemiplegia

Summary Split anterior tibialis transfer is a procedure, frequently performed in combination with triceps surae lengthening, to treat equinovarus foot deformity in adult hemiplegia patients. The authors present their surgical technique, with tendon fixation by an anchor to the base of the fifth metatarsal. Although bone-tendon anchor fixation is widespread in orthopedic surgery, it is original in this type of indication. It is simpler, and less traumatic for the bone than a bone tunnel and less traumatic for the sole than transplantar fixation. The very distal attachment to the base of the 5th metatarsal bone solves the common problem of adjusting the tension of tendon transfer. The authors report their experience of 22 split transfers from 2005 to 2008.

Introduction

Onset of spastic muscle retraction in adult hemiplegic patients often requires functional neuro-orthopedic surgery to improve ground contact and enable walking without footwear impingement. Indications are made on a case-by-case basis, usually in a multidisciplinary team meeting, bringing together physical medicine and rehabilitation physicians with neuro-orthopedic surgeons, to perform the clinical assessment and determine the treatment strategy best adapted to the patient's expectations, in a ''contract'' between the patient and the medico-surgical team [1]. Many procedures have been described, targeting firstly the soft tissue, and usually including a lengthening procedure followed by split anterior tibialis muscle transfer.

We present an original means of split anterior tibialis muscle transfer fixation by anchorage onto the 5th metatarsal base.

Surgical technique

Installation

The patient is installed in dorsal decubitus on a standard operating table, under general anesthesia.

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1877-0568/$ - see front matter © 2012 Published by Elsevier Masson SAS.
doi:10.1016/j.otsr.2012.07.007

Triceps surae lengthening

Surgery begins with a step of triceps surae lengthening. Depending on the degree of retraction, either the calcaneal tendon is lengthened by White's Z tenotomy [2], or the gastrocnemius heads are lengthened following Baker [3]. If ankle equinus is present whether the knee is in flexion or extension, then the retraction involves the entire triceps surae, and Z lengthening of the calcaneal tendon is mandatory; if, on the other hand, ankle equinus is restricted to the knee in extension, then retraction is restricted to the gastrocnemial heads, and Baker's lengthening procedure, with ankle dorsi flexion of about 10°, is feasible.

Split anterior tibialis muscle transfer

The second step is split anterior tibialis transfer. An incision of about 2 cm is made facing the navicular bone and the 1st metatarsal base to expose the distal insertion of the anterior tibialis tendon (Fig. 1). The lateral half of the tendon is then released from its bone attachment using a scalpel and fastened by suture (Fig. 2). A counter-incision 5 cm above the tibiotalar joint line (Fig. 3) exposes the semi-tendon at the tendino-muscular junction after passing through a tunnel in the extensor retinaculum (Fig. 4). The third, final, incision is made facing the 5th metatarsal base, where the split graft is to be anchored (Fig. 5). Using this approach, a subcutaneous

Figure 1 Location of distal anterior tibialis tendon insertion.

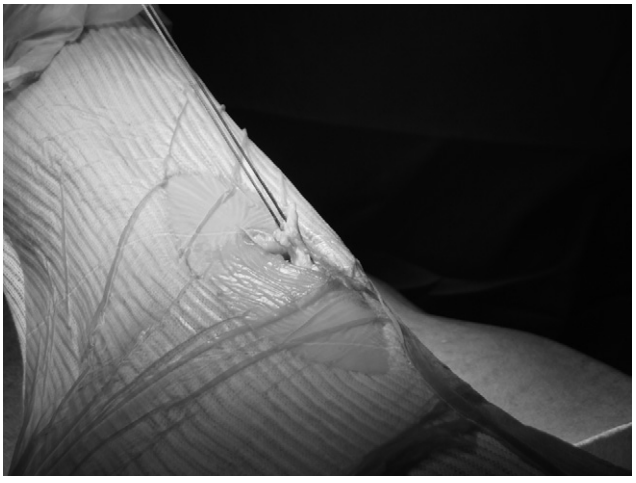

Figure 2 Suture of lateral half of the anterior tibialis tendon.

Figure 3 Incision 5 cm above the tibiotalar joint line.

Figure 4 Harvesting split anterior tibialis muscle 5 cm above the ankle at the muscle-tendon junction.

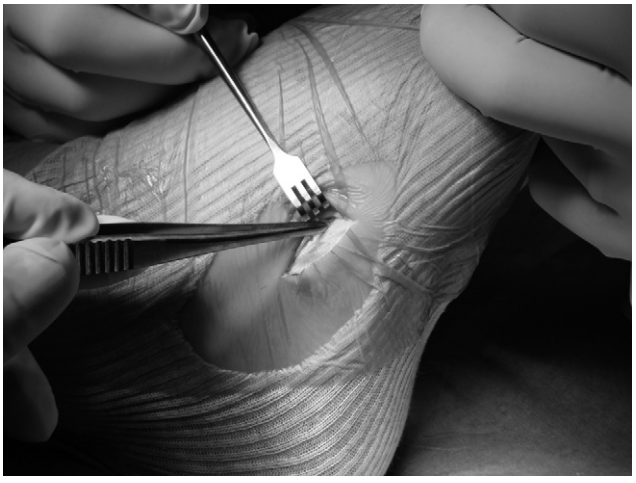

Figure 5 Third incision facing the 5th metatarsal base.

Figure 6 Creation of a subcutaneous tunnel using a long clamp, to secure the split graft and draw it toward the 5th metatarsal base.

tunnel is made by long clamp, up to the second incision so as to take hold of the distal extremity of the split graft and pull it in front of the 5th metatarsal base (Fig. 6). The metatarsal base is then exposed by bone rasp. The transfer is fixed by a 2-mm titanium anchor (DePuy® Mini Quickanchor™ Plus w 2/0 Orthocord® [V-5]) (Fig. 7) set into the base (Fig. 8) along the axis of the metatarsal. After checking the bone anchorage, the tendon is laced onto the anchor (Fig. 9). A complementary side-to-side suture reinforces the split graft onto the distal part of the fibularis brevis tendon (Fig. 10), according to the tenodesis technique described by Bardot et al. [4]. To adjust the tendon transfer tension, the foot is held in neutral position in the frontal plane during fixation, correcting the resting varus induced by anesthesia and maintaining 10° of sagittal dorsi flexion. The three surgical

Figure 7 DePuy® Mini Quickanchor™ Plus w 2/0 Orthocord® (V-5) titanium anchor.

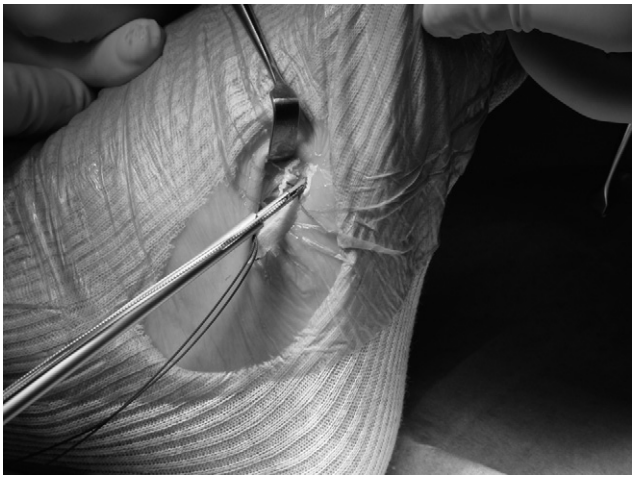

Figure 8 Anchor insertion in the 5th metatarsal base.

Figure 9 Split tendon graft fixation using the anchor sutures.

Figure 10 Complementary suture of split fibularis brevis tendon graft.

approaches are then closed without drainage, using separate stitches of bio-resorbable suture.

Postoperative management

The compress dressing is reinforced with a posterior plaster cast for 2 days, followed by non-weight-bearing cast for 21 days, replaced by a resin-walking boot for 21 more days.

Results

Our experience comprises 22 patients, aged over 15 years, seen in multidisciplinary neuro-orthopedic consultation between 2005 and 2008, who underwent surgery for varus equine foot of central origin by split anterior tibialis muscle transfer. There were 10 males and 12 females, with a mean age of 39.9 years (range, 17—76 years). The etiologies of the central pathology comprised stroke (14 patients), severe cranial trauma (four patients) and cerebral palsy (four patients). 90% considered the preoperative contract to have been fulfilled; 100% were satisfied (41%) or very satisfied (59%) with their operation. Two patients, who had been unable to walk, recovered gait. At a minimum 2 years' follow-up, there were two recurrences of deformity, and two complications: spontaneously resolved delayed healing of the surgical approach to the calcaneal tendon, and detachment of the anchor in a road accident 6 months postoperatively, without recurrence of deformity.

Discussion

There is now universal consensus that all the procedures should be performed in a single step. The advantages for patients are numerous: a single hospital stay followed by a single period of immobilization and a single rehabilitation course to acquire a new gait pattern. From a more theoretical point of view, it seems logical to act simultaneously on agonist and antagonist muscles, so as to avoid imbalance. The choice of procedures follows from the multidisciplinary preoperative team consultation meeting.

The use of an anchor to achieve bone fixation is original in this indication. Roper et al. [5], Waters et al. [6] and Vogt [7], for example, follow Mooney's technique [8], comprising a bone tunnel through the lateral cuneiform bone and suture of the graft onto itself after passing it through the tunnel. Tracy [9], Pinzur et al. [10] and Asencio et al. [11] use the same tunnel, but with transplantar fixation. Keenan et al. [12] and Hosalkar et al. [13] use an interference screw for fixation. In a recent cadaver study, Fenell et al. [14] compared resistance between the tunnel and self-suture technique and anchor fixation in a 26-foot series, and found significantly better resistance with the anchor technique; Nunez-Pereira et al. [15], on the other hand, in a series of 15 cadaver feet, found significantly better resistance with an interference screw than with the anchor technique. Anchor fixation, however, is easier to perform, with less bone trauma than in the tunnel technique and less trauma to the sole of the foot than in the transplantar fixation technique.

The fixation site varies from series to series, the preferred site being the lateral cuneiform bone [5—7,9,11]. The present choice of the 5th metatarsal base was founded on several considerations:

- simplicity, as this site is easily palpated subcutaneously on the lateral edge of the foot;
- greater valgization, fixing the graft as distally as possible to enhance leverage;
- lack of shoe-wear impingement.

A further advantage is that no change in the patient's footwear is required.

Depending on the series, there is about a mean 5% rate of detachment of interference screws or of grafts fixed via a bone tunnel [7,10,11,13]. Vogt [6] and Yamamoto et al. [16] reported recurrence rates of respectively 17.8% and 26%.

Conclusion

Split anterior tibialis muscle transfer fixation by anchor onto the 5th metatarsal base appears straightforward, reproducible and reliable, with few complications. Comparison with alternative attitudes, however, needs to be assessed in a large in vivo study before it can be definitely recommended as preferable. The distal fixation onto the 5th metatarsal base provides a solution to the frequent problem of adjusting tendon transfer tension.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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