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Surgical techniques

Double tendon transfer for correction of drop-foot

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ABSTRACT

Many conditions can cause foot drop, which makes walking difficult because the foot easily bumps into obstacles, or the knee must be kept more flexed than usual during the swing phase of gait, especially when going up stairs. Several techniques that have been described to correct foot drop rely on bone procedures or tendon transfer, with or without bone fixation. In this article, we describe a simple technique that is heavily used in leprosy-endemic countries and provides long-lasting results. It requires a double tendon transfer through the interosseous membrane of leg; the tibialis posterior and flexor digitorum longus are sutured to the tibialis anterior, and extensor hallucis longus and extensor digitorum longus, respectively, proximally to the extensor retinaculum.

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1. Introduction

Several techniques have been described to address paralytic foot drop [1–4]. Although they all correct the foot drop, they are imperfect because of the complexity of the procedure [1] or because they resort to a bone procedure [2,5], which can lead to complications. We propose using Carayon's technique, which is a simpler procedure being used in developing leprosy-endemic countries. It only requires procedures on tendons and minimally alters their lines of action.

The first tendon transfers were described by Codivilla in 1899 [6]. In 1933, Ober [7] described the transfer of the tibialis posterior onto the anterior tarsus. This technique was repeated in 1957 by Brand and Fritschi [8,9] and also Watkins et al. [10]. However, the bone procedure on the anterior tarsus was the source of failures and poor outcomes. Around the same time, Carayon et al. [11] described suturing the tendon proximally to the ankle. We will describe a variation of this technique, which has been modified over time by surgeons who have extensive experience in leprosy-endemic countries where patients are treated for foot drop secondary to acute, non-resolved peroneal neuropathy or after gluteal injection of malaria drugs [5,12–15].

2. Surgical technique

The patient is placed supine with a cushion under the buttock so that the patella points straight up; it is important to make sure the patella is not tipped medially. The contralateral leg is placed flat on a support under the thigh, with the leg hanging down. The procedure is conducted with a tourniquet to provide preventative hemostasis, without an Esmarch bandage. The patient's positioning must provide the option to flex the knee during the last stage of the procedure, either by placing a pad or cushion or by having the assistant flex the leg.

The first stage consists of Achilles tendon lengthening, which is mandatory if passive dorsiflexion of 10° cannot be obtained (i.e. 80° if the foot's normal position corresponds to 90°) when the hip and knee are extended. This is carried out through two small incisions 6–7 cm apart (Fig. 1) according to the technique described by Piriou et al. [16]; the assistant flexes the hip and rotates it externally, then flexes the knee and foot into maximal dorsiflexion. The first incision is a few centimeters above the Achilles tendon insertion and slightly offset medially; once the tendon has been freed up, about half of it can be cut from the medial side; the plantaris tendon is also cut at this point if it is distinct from the Achilles tendon. The second proximal incision in made on the mid-line, while avoiding damaging the sural nerve and the small saphenous vein. The tendon, which is already more slack, is cut laterally through slightly more than half of its width. In both cases, it is important to identify the tendon edges and have a clear view of what is being cut. Lengthening is then performed forcefully in dorsiflexion up to at

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Fig. 1. Two posterior incisions made to lengthen the Achilles tendon.

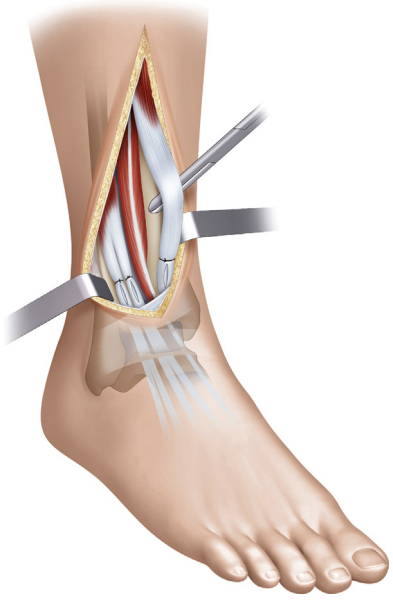

Fig. 3. Loop stitch placed on the divided tendons.

least 80°. The skin incisions are closed one by one in a single layer, without drainage.

For the second stage, the knee is extended and the leg externally rotated. A 5–6 cm incision is made behind the medial malleolus, on the assumed contour of the tibialis posterior tendon, which can be easily palpated between the medial malleolus and the tuberosity of navicular bone. The flexor retinaculum and then the sheath are opened. The tibialis posterior tendon is held with a small dissector and cut distally beyond the medial malleolus with the ankle forced into varus. It is immediately sutured in both planes with a size 2 or 3 braided sutures. It is never handled directly using blunt or serrated forceps. Behind this large tendon and in another sheath that must be opened, the flexor digitorum longus is held and sutured in a similar manner (Fig. 2). These traction sutures are used to place tension on the two tendons. Long, curved Metzenbaum scissors are introduced under the crural fascia proximally and then used to cut it subcutaneously as far away as possible over about 10 cm; this makes it easier to recover the distal ends by the anterior incision. The tendons are wrapped in moist gauze dressing to prevent desiccation.

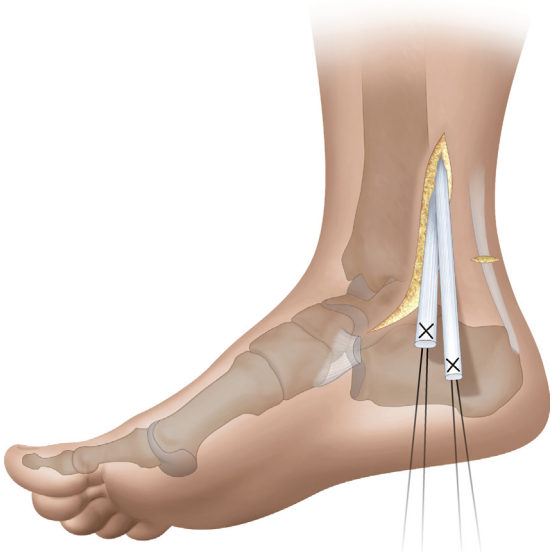

Fig. 2. Harvesting of the two tendons for transfer.

The next incision is made over the anterior compartment about 1 cm lateral to the tibial crest; the leg rotation is unimportant here. This incision is 10–12 cm long and proximal to the upper edge of the superior extensor retinaculum, which must remain intact to prevent the transferred tendons from bowing. The crural fascia is partially resected over the entire length of the incision and about 1 cm of its width. The limit between the crural fascia and the superior extensor retinaculum will be clearly visible. The transferred tendons will be sutured proximally to this retinaculum. Experience has shown that tendon fixation distally on the capsule or by an intra-osseous route is difficult to carry out. In addition, the transferred tendons have a tendency to get stuck in narrow passages or canals. One important rule of tendon transfers is that the transfer must be as direct as possible and should not pass through any narrow areas [17].

With the foot in 80° dorsiflexion, the tibialis anterior tendon and extensor digitorum longus tendon, which is often split into two tendons at this level, are circumferentially released from their synovial sheath. With the foot held in maximum dorsiflexion, the three tendons are split longitudinally over 10–12 mm up to the proximal part of the retinaculum. A reverse loop stitch must be applied to prevent propagation of the tendon division proximally; the free ends of the suture knot must be buried (Fig. 3).

The muscles of the anterior compartment and the anterior tibial vascular bundle are reflected with deep Farabeuf retractors until the interosseous membrane is released over the entire length of the incision; one or two thin Hohmann-Muller spike retractors can be placed against the fibula to provide better exposure of the interosseous membrane (Fig. 4). The membrane is completely excised between the tibia and fibula with a No. 3 long-handle scalpel. The priority is to remove the membrane proximally as opposed to distally, where the space is very narrow. At the upper end of the incision, the membrane must be completely removed; if needed, Metzenbaum scissors can be used to open it further proximal in a blinded manner.

The two tendons being transferred must be moved to a different compartment, either by recovering them in the intertibiofibular space or by grasping the two traction sutures by sliding Bengolea

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