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Minimally invasive dual-incision approach: An alternative technique to repair tibialis anterior tendon rupture. Surgical technique and case report

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Abstract

The authors present a minimally invasive surgical technique to repair tibialis anterior tendon rupture which can be used in mild and moderate retraction. Operative technique is illustrated with its different steps. Advantages and indications are specified according to the data reported in the literature.

Keywords: Tibialis anterior, tendon, repair, technique

Introduction

The tibialis anterior muscle occupies the most medial part of the antero lateral compartment of the leg. It mainly ensures the dorsal flexion of the ankle and the inversion of the foot. Distal rupture of the tendon remain a rare clinical entity that can induce a significant functional deficit and requires in most cases a surgical management. The disruption may be the result of open or closed trauma. But spontaneous atraumatic rupture can also occurred favored by predisposing factors that should be investigated.

Various repair technique has been reported in the literature using direct primary repair, tendon transfer, tendon lengthening, autograft and even allograft reconstruction.

In this observation we present an alternative technique to restore the continuity of the tendon using the hemi tendineous turn-down procedure through a two minimal surgical approach. The application of this technique in a 72 year old patient allowed recovery and good result

Case report

Mrs J.C. 72 years old active woman presented to the out patient department with footdrop gait and weakness of the left leg. The clinical history showed a chronic pain localized on the left mid foot which has been treated six month before with a local steroid injection. Three months later the patient developed a foot-slapping gait without any traumatic history.

Physical examination shows a pseudotumor at the anterior aspect of the left ankle (fig1) with a loss of the normal contour of the tibialis anterior tendon and a limited dorsi flexion comparing to the other side.

Neuromuscular testing of the other muscles shows no sensory or motor deficit. Silverskiold's test showed no retraction of the gastrocnemius muscle. The MRI confirmed the diagnosis of total rupture of the Tibialis anterior tendon at its distal part with disorganization of the parallelism of the muscle fibers at the tibial segment without signs of fatty degeneration. (fig 2a-b-c). Surgical treatment was undertaken using a double minimal approach. The first incision was centered on the swelling area at the anterior aspect of the ankle and the second on the first tarso metatarsal joint.

The proximal end of the disrupted tendon was found with a good macroscopic appearance. (fig 3a-b) We firstly relocalised it into its trajectory under the extensor retinaculum. A residual gap of 3 cm due to the tendon retraction did not allow direct suture to the remaining stump (fig 4). A hemitendineous turn-down plasty was performed. The turnaround area was secured by locking stitches (fig 5) and the suture to the remaining stump was reinforced with transosseous stitches (fig 6). The tension adjustment was performed by holding the foot in dorsal flexion position.

The ankle was immobilized with a below knee cast for 6 weeks followed by progressive rehabilitation for 3 months. The patient recover full mobility and resumed her leisure activities 6 months later (fig 7).

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At 24th month of follow-up, the left ankle remains asymptomatic. The clinical result is good with an MMSS (manual muscle strength scale) score of 4/5 and AOFAS score of 92/100 points at the last follow-up.



Fig 1: clinical aspect of a pseudotumor at the anterior aspect of the ankle corresponding to the proximal end of the ruptured tendon.



Fig 2-a: MRI sagittal view of the ankle with white arrow showing the proximal end of the tibialis anterior ruptured tendon.

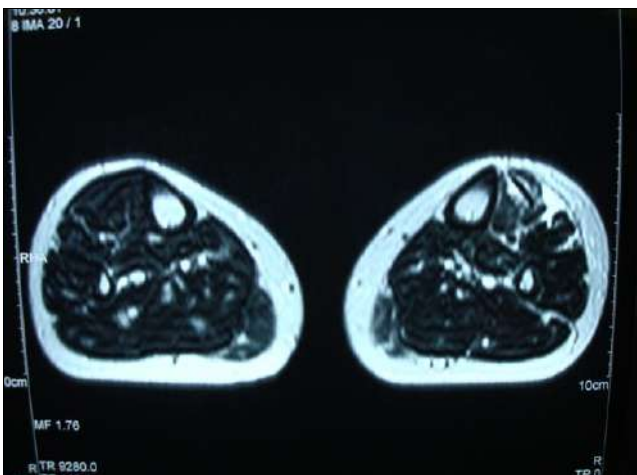


Fig 2-b: MRI axial view showing peri-musculotendinous effusion around the distal part of the tibialis anterior area



Fig 2-c: MRI sagittal view of the leg showing the disorganization of the parallelism of tibialis anterior muscle fibers as an indirect sign of the distal tendon rupture.



Fig 3(a-b): Intra operative photographs show the dual minimal surgical approach with the proximal and distal ends of the ruptured tendon.



Fig 4: Intra operative photograph showing the residual gap due to tendon retraction



Fig 5: Intra operative photographs showing the different steps for performing the hemi-tendon reversal plasty with securing of the reversal zone by multiple stitches and its relocation under the extensor retinaculum



Fig 6: Showing the distal fixation of the reversal plasty to the remaining stump reinforced by transosseous suture to the medial cuneiform

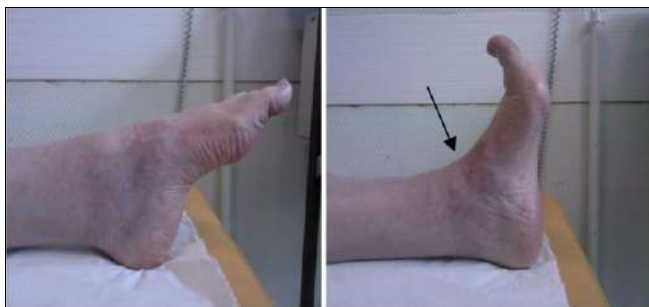


Fig 7: Clinical result at 6 months follow up. The dark arrow shows the active dorsal flexion movement due to the restored tibialis anterior tendon action and its relief on the anterior aspect of the ankle

Discussion

Rupture of tibialis anterior tendon is an infrequent injury that leads to deficit in dorsal flexion of the ankle with significant functional repercussions particularly in active patients.

Its occurrence may follow a neglected wound or after closed trauma with plantar flexion and eversion of the foot [1].

Spontaneous ruptures can also occur. They are attributed to predisposing factors such as inflammatory arthropathy, gout, repetitive strain injury, diabetes, corticosteroid therapy and local infiltrations.

The review of literature attributes the first description to Brüning in 1905 [2]. Since then, isolated clinical cases or short retrospective series have been published by different teams. The largest series includes 19 cases [3]. We have not found any prospective study reported to date.

The anatomical studies agree that the distal insertion of the tibialis anterior tendon is usually on the medial cuneiform or on the base of the first metatarsal or on both at the same time. Anatomical variations of the foot print lead some authors to classify them into different type and subgroup according to the width, shape and number of tendon expansions [4, 5, 6].

The anatomical study conducted by Wang *et al.* [4] measured the mean length of the tibialis anterior tendon which was 72.33± 5.29 mm in adults. Whereas for Olewnik *et al.* [6], these measurements varied according to the type of insertion found with values between 129.94 and 159.79 mm. These differences in measurements seems to be dependent on the geographic and ethnic origins of the dissected feet.

The level of the rupture occurs usually in the distal part of the tendon and particularly in the last 3 to 4 cm [1, 7]. This

distal location is attributed to a predisposing local intra-tendon vascular fragility [8]. A rare cases of rupture at the musculo-tendineous junction or higher in the muscle body have been reported in the literature after violent trauma in adults [9].

Clinical manifestations may be disturbed by a latent period of little symptomatology which causes a delay in diagnosis. Partial compensation by the action of the extensor hallucis longus and the extensor digitorum communis is the cause. Usually, there is a triad including stepping, swelling on the anterior aspect of the ankle and disappearance of the tendon relief [1]. Concomitant tendon rupture of the extensor hallucis longus have been reported in the literature requiring careful examination of the foot [10]. In late cases, claw toes due to compensatory overstrain, lowering of the head of the first metatarsal and retraction of the Achilles tendon may be present [11, 12].

The ultrasounds and MRI are very useful to confirm the diagnosis. Both imaging modalities are useful in differentiating partial from complete ruptures and in estimating defect size.

The ultrasounds offers a dynamic study but MRI remains the gold standard [13] and has the advantage of including during the exploration the entire tibialis anterior muscle with the surrounding structures. It allows also an analysis of the trophicity of the ruptured tendon, thus determining the optimal modality of treatment.

In the literature, there is no clearly established consensus for the management of this lesion, but analysis of systematic review articles leads to a distinction between recent lesions and lesions older than three months [11, 14].

In recent lesions all the authors advocate surgical repair. In cases seen late conservative treatment is reserved only for elderly patients with little activity or when there is a contraindication to surgery.

This conservative treatment consist of strengthening the other muscles of the ankle and using foot lifting orthoses to fight against stepping.

In all other cases surgical treatment remains the rule.

Only the study reported by Macarian *et al.* [15] including 16 cases did not find a significant difference between conservative and surgical treatment. All the other studies agree on the superiority of the surgical treatment in active patients [1, 11, 14].

Various repair techniques have been reported in the literature. Their principle is to restore the action of the tibialis anterior tendon by restoring its anatomical insertion or by inserting it on neighboring structures.

The direct suturing remains the simplest procedure. When retraction is present, several techniques are used which give usually good results. These techniques include tenodesis at the extensor retinaculum, fixation at the neck of the talus, distal sliding plasty, tendon transfer, interposition grafting, and allografting [11, 14].

Principles and indications of our technique

The splitting of the tibialis anterior tendon is widely used in balancing surgery for treatment of neurological foot [16]. By analogy we propose to use the hemitendon of the tibialis anterior through a double minimally invasive incision as a reversal plasty to ensure the continuity in case of rupture with mild or moderate retraction.

This technique has a several advantages:

- The procedure avoid the use of other tendons and ligaments of the ankle and foot
- Action and course of the tibialis anterior tendon is restored in its usual trajectory.
- It is a minimally invasive approach that theoretically reduce the risk of scar adhesion in addition to aesthetic advantage
- No specific ancillary material is required.

The technique is intended when retraction is less than 4 cm. The presence of a larger retraction, atrophy or distal tendon necrosis requires other repair techniques.

As with the other techniques the tension of the reversed plasty is adjusted by maintaining the dorsal flexion of the ankle during repair and protected by below knee immobilization for 6 to 8 weeks.

Anagnostakos *et al.* ^[5] recommended the principle of turning down the hemi-tendon when the retraction is less than 4 cm. Tickner *et al.* ^[14] in a recent systematic review of 155 cases, analyzed the results of the publications according to the repair techniques used and concluded that repairs using technique similar to the one we performed were successful while tendon transfer of the extensor hallucis longus seems to give less good results.

With a 24-month follow-up, we obtained a good result with an AOFAS score of 92/100 points and MMSS score of 4/5. These agree with the isokinetic analysis at 27, 9 months of follow up study reported in the literature by Kopp *et al.* ^[17].

Conclusion

The hemi-tendon reversal plasty performed by a double minimally invasive approach is a technical variant that we propose. It is intended for ruptures of the tibialis anterior tendon with a retraction of less than 4 cm. It has the advantage of being simple and able to restor the anatomical path and action of the tendon.

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Declaration of competing interest

The authors declare no conflict of interest.

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