Case report

SURGICAL CORRECTION OF FLATFOOT DUE TO INJURY TO THE POSTERIOR TIBIAL MUSCLE TENDON: CASE REPORT

ABSTRACT

Aims: This article aims to reportand describethe surgical application of a technique that is underrepresented in scientific literature.
Presentation of Case:A 44-year-old female patient who was diagnosed with a low-energy sprain of the right ankle, resulting in rupture of the posterior tibial tendon and additional injuries to the ligaments and tendons, presenting with acute flatfoot deformity. Surgical treatment was suggested and a surgical approach involving a reconstruction with a hamstring autograft was performed.
Discussion: The surgical application of this technique is little explored in the scientific literature, but it was considered advantageous as it aims to better preserve the future stability of the foot and ankle.
Conclusion: The surgical procedure involved a series of meticulous steps, underscoring the rarity and clinical significance of this technique in improving patient mobility outcomes. The involvement of a multidisciplinary surgical team highlights the critical role of collaborative efforts in managing complex orthopedic conditions. Ultimately, the patient achieved restoration of the physiological anatomy of the foot. This marked the beginning of a crucial phase requiring intensive postoperative care and specialized follow-up to ensure optimal recovery and long-term functional outcomes.

Keywords:Flatfoot; Hamstring; Arthroscopy; Posterior Tibial Tendon Dysfunction.

1. INTRODUCTION

Rupture of the posterior tibial tendon (PTT) is often associated with the acquisition of flatfoot deformity in adults[1] like wise add refences (Bluman EM*et al*, 2007)and is commonly correlated with a collapse of the medial longitudinal arch with arthritic or traumatic etiology(Henry JK*et al*, 2019). In Johson and Strom's stage II (Johnson KA and Strom DE, 1989), the predominant surgical approach has been flexor digitorum longus (FDL) tendon transfer, combined with lateral column lengthening and/or calcaneal osteotomy with medial displacement (Dominick, DR and Catanzariti, A.R, 2020). However, the disadvantages associated with FDL transfer are widely recognized in scientific literature (Kelly MJ *et al*, 2021), showing a significant difference in plantar flexor power compared to PTT. This disparity results in a limitation of the FDL in the hindfoot. It is noteworthy that the specific surgical technique for reconstruction of the posterior tibial tendon with hamstring graft, especially in traumatic cases, is poorly reported in scientific literature. This gap highlights the need for more comprehensive studies that explore and document the effectiveness of this approach to restoring the plantar arch, with the aim of correcting the flatfoot associated with PTT rupture, which is what the present study conducted by the authors guided by the means of the CARE 2013 checklist set out to do. However, disadvantages of transferring the FDL have been described, (Cottom JM *et al*, 2021) being revealed a difference in relation to the plantar flexor power of the foot, in which the torque of the FDL is half that of the PTT, and Hui *et al* (Mercer NP*et al*, 2021) who reported the limitation of the FDL in the hindfoot. Therefore, in this specific case, an exceptional factor was the use of the semitendinosus and gracilis tendons for the graft, with the aim of restoring the medial and transverse plantar arch, in order to correct the flatfoot.

2. PRESENTATION OF CASE

We report the case of a 44-year-old woman who works as a home care worker, who presented with a right ankle sprain with the main complaint of acute pain, aggravated by movement and without noticeable relief. The evolution of the case revealed edema in the lateral and medial malleolar regions, accompanied by persistent pain during walking and other movements. Initially, an X-ray of the right lower limb was taken and conservative treatment with immobilization was indicated. However, the patient chose to remove the immobilization on her own, even though the pain continued.

One year and four months after the sprain, the patient reported a significant worsening of her pain, associated with difficulty walking and progressively worsening edema.However, a subsequent Magnetic resonance imaging (MRI)scan presented diagnostic impressions revealing a reduced longitudinal plantar arch, associated with minimal subluxation of the calcaneocuboid joint and subcutaneous periarticular edema, mainly in the perimalleolar regions. The examination also indicated a complete rupture of the retromalleolar portion of the posterior tibial tendon, with the distal stump located at the level of the lower portion of the head of the talus, and the proximal stump retracted superiorly, located close to the medial malleolus.

The results were interpreted by the surgical team, who classified the patient's flat foot as Johson and Strom stage II (Johnson KA and Strom DE, 1989). Notable deformities included a flexible flat foot, flat arch, abduction of the forefoot and valgus misalignment of the hindfoot, as illustrated in figure 1. In view of this assessment, surgical treatment was indicated, and the patient was duly instructed to follow this approach.

Figure 1 -Medial view (A) of the normal left ankle and medial view of the right ankle (B) with collapse.

The patient underwent a comprehensive surgical treatment for tendon reconstruction and ligament reinforcement, with the aim of correcting the flatfoot acquired as a result of a traumatic injury. The procedure included both arthroscopic and open interventions, with an emphasis on tenorrhaphy of the posterior tibial tendon, using a semitendinosus graft.

The incision was made for posterior access to the right medial malleolus, extending to the medial region of the right foot. Plane dissection allowed visualization of the proximal stump of the posterior tibial tendon, attached to the medial malleolus and the neurovascular bundle, as shown in figure 2. Next, an incision was made in the proximal anteromedial region of the right knee, in the area of the insertion of the anserine foot, measuring approximately 2 cm. Plane dissection allowed the semitendinosus tendons to be identified and removed for grafting, using a long stripper, followed by preparation of the graft tendons with triple folding and the use of Ethibond wires. A crude reduction of the talonavicular joint was performed and fixed with a 2.5mm Kirchner wire.

Figure 2 - Proximal stump of the posterior tibial tendon.

A metal anchor was then inserted into the head of the right talus under fluoroscopic control. The "ligamentum mola" was reconstructed and retensioned using fiber wire. The flexor tendon retinaculum was then opened, followed by tenorrhaphy of the posterior tibial tendon in "puvertaf", as shown in figure 3, using the graft removed as described above.

Figure 3 – Tenorrhaphy of the posterior tibial tendon in "puvertaf.

A tunnel was created in the navicular bone to fix the posterior tibial tendon to the graft, using a 7/20mm interference screw with satisfactory tendon tension. This stage was completed with the reconstruction of the posterior tibial retinaculum, the final aspect of which is shown in figure 4, where it is possible to see the satisfactory correction of the plantar arch, with the formation of a medial cavus at the time of surgery.

Figure 4 - Final aspect of the reconstruction with inserted graft and constructed retinaculum

In the context of arthroscopy, access was gained via a double portal anterior to the right ankle. Using a video arthroscope, anterior synovectomy, removal of free bodies and resection of an anterior impingement osteophyte were performed. After these procedures, suturing by planes, removal of the pneumatic tourniquet, hemostatic revision and sterile dressing were performed. The Kirschner wire and immobilization splint were removed 40 days after surgery.

Follow-up with the medical team was conducted after a few weeks.No significant adverse effects were observed due to the surgical intervention. The patient was advised to undergo physiotherapy to recover movement. Additionally, podoscopy was performed to assess the patient's foot structure and function during the follow-up period, as shown in figure 5, showed satisfactory results.

Figure 5 - Podoscopy of the patient, post-surgery

Also add the pre surgical padoscopy so that everyone see the difference between pre and post

The patient reported no significant adverse effects and had satisfactory balance. There was temporary paresthesia in the plantar region of the foot due to the neurolysis of the posterior bundle, which was attached to the stump of the posterior tibial tendon. The patient denied any complaints of pain during ambulation, and the ability to dorsiflex and invert the right foot was preserved. Outpatient assessment of the patient's transverse and longitudinal arch in the office, via podo copy.

3. DISCUSSION

The PTT is the largest and most anterior tendon of the medial ankle, crucial for strong inversion of the hindfoot, adduction of the forefoot, and moderate pronation of the forefoot (Knapp PW *et al*, 2024). Certain factors contribute to the higher occurrence of acute spontaneous rupture of the PTT. The region where the posterior tibial tendon wraps around the medial malleolus, being avascular and composed of fibrocartilaginous tissue, is at risk of degeneration and spontaneous rupture if subjected to repetitive stresses in sports activities (Macedo RS*et al*, 2022). It was noted that this retromalleolar anatomical situation of the PTT is the least mobile due to its passage under the retinaculum, making it prone to rupture with medial malleolus fractures (Cataldi C*et al*, 2020).

Another situation is highlighted that chronic repetitive low-energy trauma generally causes the PTT to fail and rupture, which resembles the case presented in this work (Magan P *et al*, 2022). Acute rupture in the absence of an ankle fracture is uncommon and was first described by Monto *et al*. (Monto RR*et al*, 1991). Therefore, the differential in our patient's case was that she suffered a complete rupture of the retromalleolar portion of the posterior tibial tendon, located near the medial malleolus, triggered by an incident of medial ankle sprain on the right side—meaning a low-energy trauma without fracture—that evolved into a rupture due to the favorable anatomical structure, even in cases involving low kinetic energy(Lesiak AC *et al*, 2020).

As previously mentioned, PTT dysfunction is the main cause of acquired flatfootcommonly associated with stage II of the disease (Núñez-Samper M*et al*, 2021). This condition is characterized by an imbalance between the forces that tend to flatten the arch and those that support it, potentially leading to the loss and/or collapse of the medial longitudinal arch, as presented in the pre-surgical evaluation case description. The indicated surgical treatment in this case is tendon transfer for PTT reconstruction, promoting the correction of flatfoot (El Rayes J*et al*, 2019).

The surgical treatment of our patient was performed considering that she suffered an acute injury because, despite the condition having evolved over one year, the PTT adhered to the tibia and did not retract irreversibly. Thus, reconstruction was possible using a hamstring tendon autograft without sacrificing the foot tendons with a muscle transfer, which is a rarely reported situation in the literature, reinforcing the rarity of this surgical technique performed by the professionals in this case report. However, we had the materials available to perform osteotomies and arthrodesis as another intervention plan if necessary.

The use of the semitendinosus and gracilis tendons for PTT transfer and reconstruction proved advantageous because, despite adding morbidity to the donor area, this transfer is guaranteed since preserving all the foot and ankle tendons avoids potential future instability (Craft M*et al*, 2024). Moreover, harvesting hamstring tendons is considered an easy and safe procedure, which, although it can cause knee weakness, has clinical and functional outcomes similar to the uninjured leg (Park SH*et al*, 2020). For example, the FDL (Flexor digitorum longus), generally used for grafting in PTT reconstruction, has an important biomechanical function in the foot, so harvesting this tendon can compromise its function (Thaunat M*et al*, 2019). Hamstring tendon grafts (from the semimembranosus, semitendinosus, and biceps femoris muscles) have been widely used to replace ruptured anterior cruciate ligamentsand Achilles tendon reconstructio(Von Essen C*et al*, 2022).Therefore, we decided to use our patient's semitendinosus and gracilis tendons to replace the ruptured PTT and restore the medial plantar arch, correcting the flatfoot (Beger O *et al*, 2019).

The surgical team responsible for the procedure did not observe any potential limitations in performing the surgery, given that clinical and imaging exams indicated the need for invasive surgical intervention to correct the observed longitudinal and transverse plantar arches in pre-surgical medical evaluations.

4. CONCLUSION

Considering the above, the conclusion regarding the patient who underwent surgical treatment to reconstruct the longitudinal and transverse arches in the right foot, aiming to correct a clinical case of flatfoot, also known as pes cavus or tarsal coalition, reveals the complexity and scope of the intervention performed using the semitendinosus tendon to restore the mobility and functionality of the right lower limb. The surgical procedure itself involved a series of meticulous steps, from the preparatory phase in the operating room to the execution of specific interventions, delineating a complex and detailed surgical scenario. This makes such a surgical technique rare but significant in terms of the patient's mobility outcomes.

The involvement of a multidisciplinary surgical team highlights the critical role of collaborative efforts in managing complex orthopedicchallenges. The use of technologies such as fluoroscopy and ankle arthroscopy demonstrate the advanced approach adopted during the surgery, seeking precision and anatomical correction.

Post-surgical rehabilitation plays a crucial role in ensuring the integrity of human movement. From the initial phase of care, such as asepsis and antisepsis, to specific interventions for foot reconstruction, each step is aimed not only at anatomical restoration but also at achieving proper functionality and mobility. The satisfactory visualization of the correction of flatfoot with the formation of the medial arch, as evidenced in the images, represents a promising indicator of the intervention's success. The recovery of the physiological anatomy of the foot in the right lower limb, although a significant step, does not mark the end of the process but rather the beginning of a crucial phase that demands intensive postoperative care and specialized follow-up to ensure adequate recovery.

CONSENT

All authors declare that written informed consent was obtained from the patient for publication of this case report and accompanying images.

ETHICAL APPROVAL

The study was reviewed and approved by the Research Ethics Committee under the registration number CAAE: 76853424.5.0000.5076.

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with ethical standards.

DISCLAIMER (USE OF ARTIFICIAL INTELLIGENCE)

The authors acknowledge the use of GPT-4 for rewriting and editing this manuscript, specifically for refining the English grammar of the translated text, which was originally written in Brazilian Portuguese. The AI's role was strictly limited to improving the grammatical accuracy and ensuring alignment with academic language standards, without adding any new information to the text. The details of AI usage are as follows:

1. The original manuscript, written in Brazilian Portuguese, was translated into English, and AI was employed to enhance the grammatical quality of the final version, adhering to academic English conventions.
2. Carefully designed prompts were used to guide the AI in making grammatical corrections and verifying the translation’s consistency with academic norms.

DEFINITIONS, ACRONYMS, ABBREVIATIONS

PTT:posterior tibial tendon.

FDL: flexor digitorum longus.

MRI: Magnetic resonance imaging.

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