Surgical Correction of Flatfoot Due to Injury to The Posterior Tibial Muscle Tendon: A Case Report

ABSTRACT

Aims: This article aims to reportand describe the 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 posterior tibial tendon (PTT) is crucial for foot movement and is prone to rupture due to its anatomical structure, primarily caused by repetitive stress and ankle fractures. Therefore, the case described is unusual because it involved a complete rupture of the PTT triggered by a low-energy trauma. PTT dysfunction can lead to acquired flatfoot, which occurred in our patient, who was classified as being in stage II of the disease. The recommended treatment for this case is posterior tibial tendon reconstruction through tendon transfer. To achieve this, a hamstring tendon autograft was used without sacrificing the foot tendons with a muscle transfer, a rarely reported situation in the literature, but one that proved to offer better outcomes for the patient.
Conclusion: This case report discusses stage II flatfoot from posterior tibial tendon (PTT) rupture due to low-energy trauma. Surgical repair using autografts from gracilis and semitendinosus muscles showed favorable outcomes compared to the traditional flexor digitorum longus tendon method. Further studies are needed to establish consensus on this approach.

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(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, disadvantages of transferring the FDL have been described, (Kelly MJ *et al*, 2021; 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 (Hui HE *et al*, 2007).
The reconstruction of the posterior tibial tendon using a hamstring graft, particularly in traumatic cases, is notably underreported in the scientific literature. This gap underscores the need for more comprehensive studies to evaluate and document the effectiveness of this technique in restoring the plantar arch. In this case, a distinct approach was adopted, utilizing the semitendinosus and gracilis tendons as grafts. The primary goal was to restore

both the medial and transverse plantar arches, addressing the flatfoot condition. Accordingly, this case report seeks to detail and describe the surgical application of a technique that remains underrepresented in current scientific literature.

2. CASE PRESENTATION

A 44-year-old female patient presented with a right ankle sprain following a ground-level fall, consistent with a low-energy trauma mechanism. Her primary complaint was acute, movement-aggravated pain, with no alleviating factors. The initial clinical course was marked by edema localized to the medial and lateral malleolar regions, accompanied by persistent pain during ambulation and other movements. Radiographic imaging was performed, which excluded the presence of any fracture, and conservative management, including immobilization, was recommended. However, the patient discontinued the prescribed immobilization independently, despite ongoing symptoms.

Approximately 16 months post-injury, the patient reported a significant exacerbation of symptoms and sought further medical evaluation. Examination revealed a complete rupture of the retromalleolar portion of the posterior tibial tendon, with the distal tendon stump identified at the level of the inferior aspect of the talar head and the proximal stump retracted superiorly near the medial malleolus. Magnetic resonance imaging (MRI) demonstrated a marked longitudinal collapse of the plantar arch, minimal subluxation of the calcaneocuboid joint, and evidence of periarticular edema.

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.

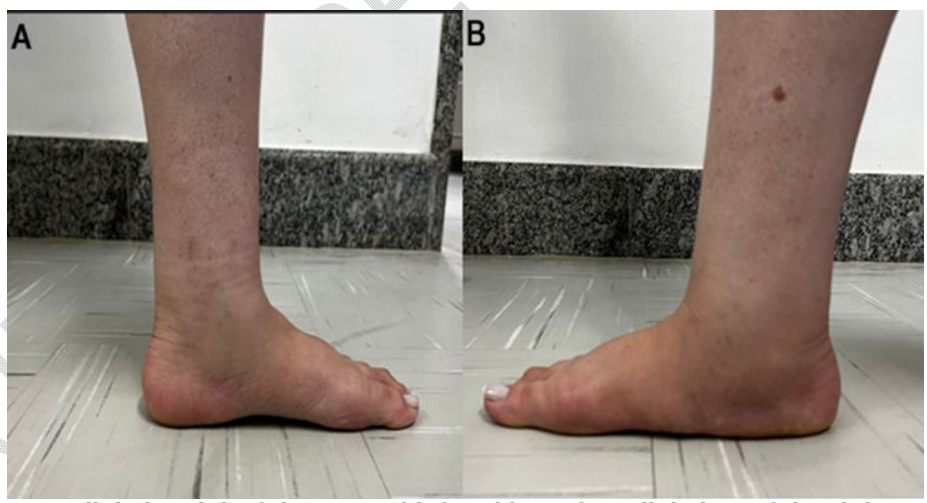

Figure 1: Medial view (A) of the normal left ankle and medial view of the right ankle (B) with collapse.
Source: Personal collection

The patient underwent comprehensive surgical treatment for tendon reconstruction and ligament reinforcement, aimed at correcting flatfoot acquired due to a traumatic injury. The procedure combined arthroscopic and open techniques, with a focus on posterior tibial tendon tenorrhaphy 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.

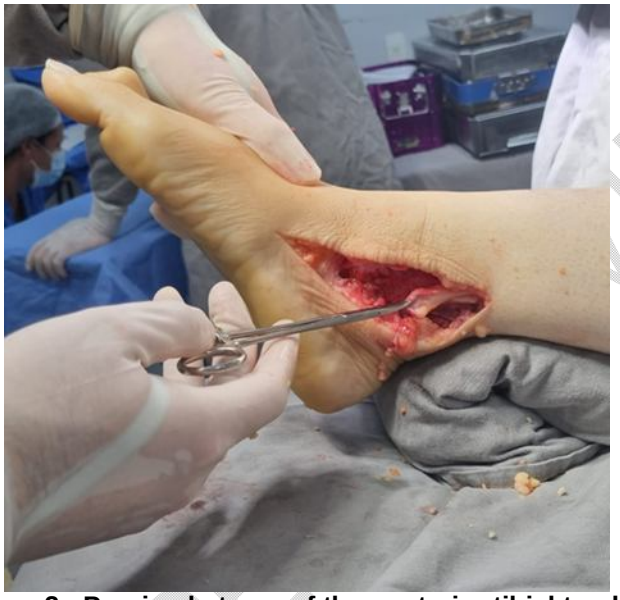

Figure 2 - Proximal stump of the posterior tibial tendon.
Source: Personal collection.

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 "pulvertaft", as shown in figure 3, using the graft removed as described above.

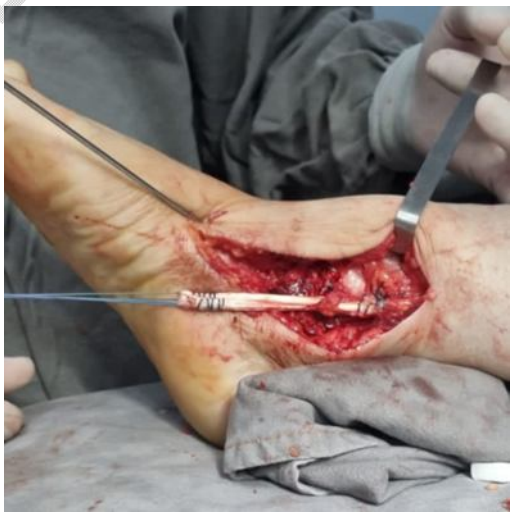

Figure 3 – Proximal stump of the posterior tibial tendon (PTT) following tenorrhaphy with autograft using the Pulvertaft technique.
Source: Personal collection.

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.

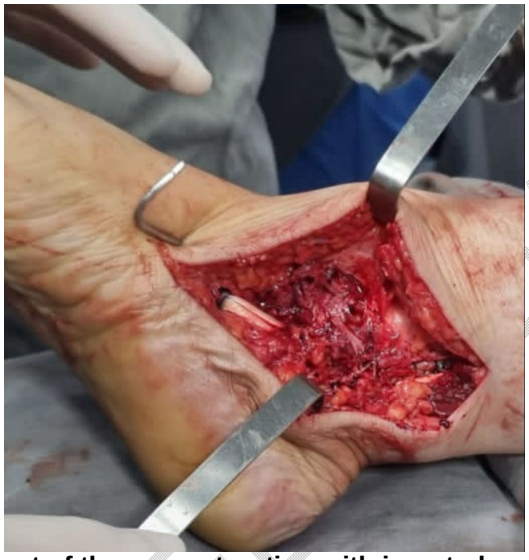

Figure 4 - Final aspect of the reconstruction with inserted graft and constructed retinaculum.
Source: Personal collection.

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.

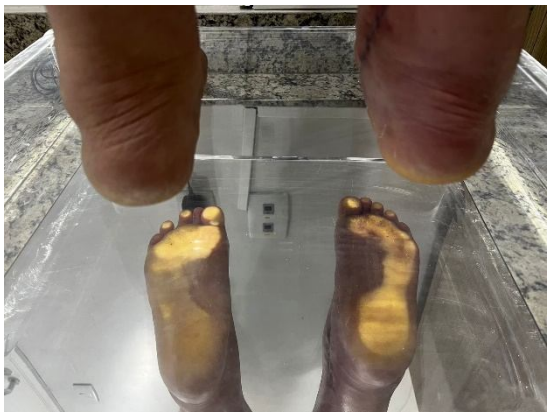

Figure 5 - Podoscopy of the patient, post-surgery.
Source: Personal collection.

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 podoscopy.

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*, 2022). 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 reconstruction (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).

4. CONCLUSION

This is a case report of a stage II flatfoot, as classified by Johnson and Strom, resulting from a posterior tibial tendon (PTT) rupture caused by a low-energy trauma. The surgical approach involved tenorrhaphy using autografts from the gracilis and semitendinosus muscles, which demonstrated favorable outcomes compared to the conventional technique that utilizes the flexor digitorum longus tendon. This surgical method shows potential in the treatment of flatfoot secondary to PTT rupture. However, there is a notable lack of studies in the literature to establish a consensus on this approach. For this reason, it is crucial to document and disseminate this alternative technique to contribute to the scientific body of knowledge.

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 case was carefully analyzed, and data were collected following the ethical standards established by the guidelines of Resolution No. 580 of 2018. Data collection was based on the CARE (Case Report) guidelines, and the following data were assessed: medical records, the report of the doctor in charge, and the results of magnetic resonance imaging (MRI) and radiographs.

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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