Weight-bearing Ultrasound to Diagnose Talar Dislocation Causing Tarsal Tunnel Syndrome

Márcio Luís Duarte[1], Mayara Oliveira da Silva[2], Ocacir de Souza Reis Soares[3], Norma Sueli Albino Moreira[4], Eduardo Kenzo Arie[5]

[1] Universidade de Ribeirão Preto – Campus Guarujá, Guarujá (SP), Brazil;
[2] Universidade Federal de São Paulo, Santos (SP), Brazil;
[3] Clínica Radiológica Ocacir Soares, Presidente Prudente, São Paulo, Brazil;
[4] Hospital Brasil, Santo André (SP), Brazil;
[5] Irmandade da Santa Casa de Misericórdia de Santos, Santos (SP), Brazil

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Abstract: The neuropathic compression of the tibial nerve and/or its branches on the medial side of the ankle is called tarsal tunnel syndrome (TTS). Patients with TTS presents pain, paresthesia, hypoesthesia, hyperesthesia, muscle cramps or numbness which affects the sole of the foot, the heel, or both. The clinical diagnosis is challenging because of the fairly non-specific and several symptomatology. We demonstrate a case of TTS caused by medial dislocation of the talar bone on the calcaneus bone impacting the tibial nerve diagnosed only by ultrasound with the patient in the standing position.

Mailing Address: Dr. Márcio Luís Duarte, Department of Radiology, Universidade de Ribeirão Preto (UNAERP) – Campus Guarujá, Av. D. Pedro I, 3.300, Enseada, Guarujá (SP), 11440-003, Brazil; Phone: 005 513 339 810 00; e-mail: marcioluisduarte@gmail.com

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Introduction

The tibial nerve goes by via the medial flank of the ankle and branches into the branches: medial plantar nerve, lateral plantar nerve, and medial calcaneal branch. This location is named the tarsal tunnel and is formed of the posterior tibial tendon, long flexor tendon of the fingers, neurovascular bundle, and flexor hallucis longus tendon (medial to lateral). Thus, little modifications in this area can easily result in neuropathy (de Souza Reis Soares et al., 2022).

The neuropathic compression of the tibial nerve and/or its branches on the medial side of the ankle is called tarsal tunnel syndrome (TTS). It has several etiologies, and the nature of the squeeze is detected in around 60–80% of the patients (Fantino et al., 2011). It is a difficult diagnosis that comprises manifestations originating from injury to the posterior tibial nerve or its branches as they move via the tarsal tunnel below the flexor retinaculum in the medial ankle. Although it is considered rare, TTS is easily overlooked and underdiagnosed (Tawfik et al., 2016). The prevalence of TTS established on electrophysiological investigations is registered as 0.4–0.5% (Khodatars et al., 2022).

Patients with TTS presents pain, paresthesia, hypoesthesia, hyperesthesia, muscle cramps or numbness which affects the sole of the foot, the heel, or both; the symptoms can appear during walking or exercise (Fantino, 2014). TTS can mimic plantar fasciitis (Khodatars et al., 2022). When the patient in at rest the symptoms can appear at night. The dorsiflexion and eversion of the foot can provoke the symptoms. Physical examination may show a potential deformation of the foot – varus or valgus deformity (Fantino, 2014). The clinical diagnosis is challenging because of the fairly non-specific and several symptomatology. Electrophysiological investigations can be non-specific and can be normal in 30% of the cases (Khodatars et al., 2022).

We demonstrate a case of TTS caused by medial dislocation of the talar bone on the calcaneus bone impacting the tibial nerve diagnosed by ultrasound with the patient in the standing position.

Case report

A 30-year-old man reported pain and numbness in the medial region of both ankles for five years. He refers worsening when walking or standing for a long time limiting him from walking distances greater than 100 meters. With this limitation, he stopped to play sports. On physical examination, he presents bilateral flatfoot (Figure 1) and normal movements of the ankles, but has a bilateral positive Tinel's sign in the tibial nerve region. He denies previous surgeries and traumas.

The patient has an electromyography diagnosing TTS and a normal magnetic resonance imaging (MRI). Bilateral ankle ultrasound without load does detect tibial

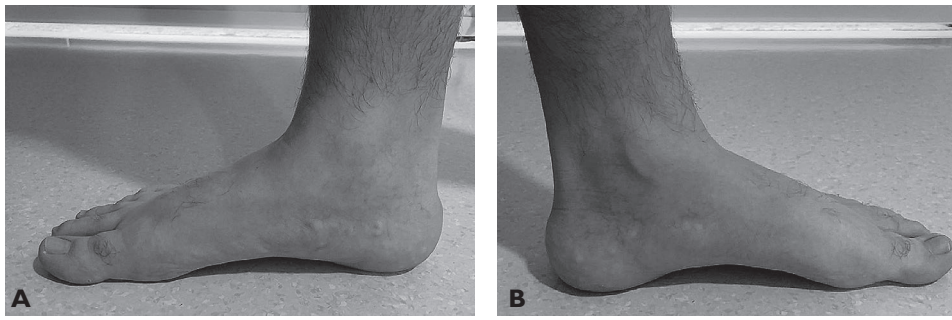

Figure 1 – A) Right flatfoot foot. B) Left flatfoot foot.

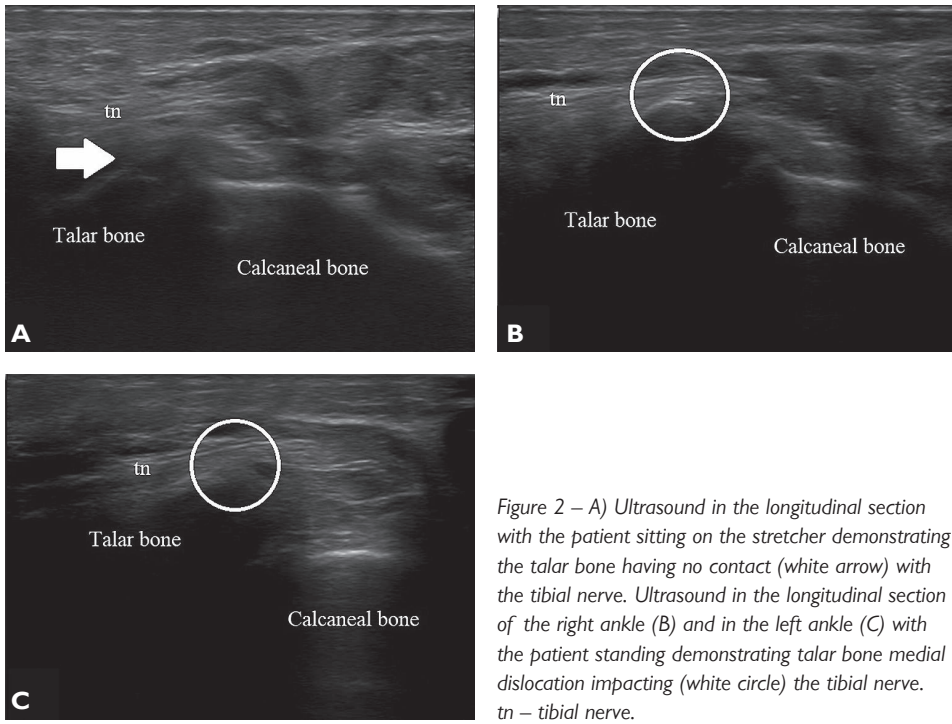

Figure 2 – A) Ultrasound in the longitudinal section with the patient sitting on the stretcher demonstrating the talar bone having no contact (white arrow) with the tibial nerve. Ultrasound in the longitudinal section of the right ankle (B) and in the left ankle (C) with the patient standing demonstrating talar bone medial dislocation impacting (white circle) the tibial nerve. tn – tibial nerve.

nerve enlargement – cross-sectional area of the right tibial nerve was 0.22 cm^2 and the left tibial nerve was 0.20 cm^2. In the ultrasound study with the patient standing, 0.5 cm of medial dislocation of the talar bone on the calcaneus bone is observed impacting the tibial nerve in both ankles, characterizing TTS caused by medial talar dislocation (Figure 2).

With the diagnosis, a bone arthrodesis with a screw between the talar and calcaneal bones was performed (Figure 3). Following surgery, the patient performed

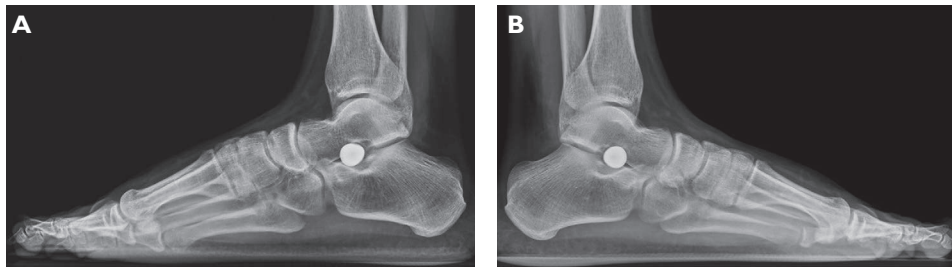

Figure 3 – Lateral X-ray of the right foot (A) and left foot (B), showing arthrodesis with a screw between the talar and calcaneal bones.

physiotherapy for six months and, after this period, the ultrasound with the patient standing was normal. The patient refers no symptoms and affirms he even played soccer for the first time since symptoms emerged reporting improvement of your quality of life.

Discussion

Changing the foot posture can affect the alignment of the tibia, talus, or calcaneus. Hindfoot valgus, tibia valgus, talus valgus, calcaneal valgus, flatfoot deformity, talocalcaneal coalition, or supination are possible bone causes of TTS. Radiography and computed tomography (CT) scan permit for examination of tarsal tunnel bone anatomy and pathology which have been implicated in patients with suspected TTS (Khodatars et al., 2022). A bone can touch or impact the tibial nerve or its branch (de Souza Reis Soares et al., 2022).

Longitudinal images with ultrasound enable the evaluation of bone alignment. When the ultrasound is performed with the patient in the standing position the sensitivity of TTS grows. The medial process of the talus touch or even compresses the distal portions of the tibial and plantar nerves (de Souza Reis Soares et al., 2022). Weight-bearing radiographs and/or CT scans (weight-bearing or conventional) are the tests of preference for recognizing hindfoot valgus, talus dislocation or varus deformity. Imaging of both ankles should be executed to compare them (Khodatars et al., 2022). Ultrasound, as demonstrated is this case, can diagnose both: talus dislocation and nerve compression.

Tinel's test can be executed with ultrasound by touching the nerve to induce symptoms. If positive, TTS is the leading diagnostic hypothesis, notably when symptoms are associated to potential causes of compression (Fantino, 2014). Due to superficial location of tibial nerve, ultrasound can reveal morphological peripheral nerve lesions that can be related to neuritis/neuropathy like hypoechogenicity, partial or complete loss of echogenic fat, and fascicular morphology with a definition

better than MRI (Samarawickrama et al., 2016). This is one of the reasons that ultrasonography should be performed routinely when the syndrome of the tarsal tunnel is suspected (Fantino, 2014).

Ultrasonography offers the advantage of detecting small injuries that may not always be identifiable on MRI scans. Furthermore, the ultrasound dynamic method enables the evaluation of nerve compressibility due to vascular causes, such as varicosities and arterial tortuosity. Ultrasound has a crucial role in pre-operative appraisal and description and can aid for minimally invasive procedure in some cases, like ganglia's comprising the tibial nerve that can be aspirated (Khodatars et al., 2022).

Although MRI is considered the imaging gold standard test for the diagnosis TTS, the role of ultrasound is increasing thanks to several advantages in relation to MRI, such as (Fantino, 2014; Tawfik et al., 2016):

- Better spatial resolution compared to MRI
- Quicker examination performing axial scans (elevator technique)
- Dynamic analysis and the possibility to perform the test with the patient in the standing position
- Positive ultrasound Tinel sign can be detected
- Doppler ultrasound analysis
- Is cheaper and has a widespread availability compared to MRI

Ultrasonography can be performed with the patient in the standing position – position in which CT scan and MRI cannot be performed routinely nowadays – detecting precisely the talar dislocation touching or even compressing the tibial nerve, as illustrated in this case, or its branches – medial plantar nerve or lateral plantar nerve. To avoid false-positive or false-negative errors, the sonographer must be aware that cause of TTS is one that compresses, displaces or touches the tibial nerve or its branches. The most common differential diagnosis is plantar fasciitis which is easily evaluated with ultrasound (de Souza Reis Soares et al., 2022).

Ultrasound imaging has some limitations. Ultrasound is operator dependent, and to diagnose TTS, the sonographer must know the anatomy of the tarsal tunnel and the possible causes of the syndrome. In some cases, video files enhance the quality of data supplied and improve understanding. Ultrasound delivers details on the morphology, but not on the harshness of the neuropathy and the effect on the nerve. Also, this test does not assess the function of the nerve. Ultrasound does not distinguish muscle edema provoked by denervation like MRI (Fantino et al., 2011). Obesity can also limit the utility of ultrasound (de Souza Reis Soares et al., 2022).

Conclusion

Although TTS has several possible causes, some of them are better evaluated with ultrasound, mainly when the analysis in the standing position is necessary. Ultrasound

has a better resolution of the tibial nerve and its branches when compared to MRI, but is an operator-dependent technique, requiring the knowledge of the different sorts of causes of TTS and their imaging appearances to permit an accurate diagnosis.

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