

# Inconstant high bifurcation of tibial nerve found in posterior ankle arthroscopy. A case report

## Bifurcação alta e inconstante do nervo tibial observada na artroscopia posterior do tornozelo: relato de caso

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### ABSTRACT

Endoscopy for the posterior region of the ankle is becoming more widespread for the treatment of a large number of conditions which used to be treated with open surgery years ago including posterior impingement syndromes, like symptomatic Os trigonum and posterior prominent talar process. This case report describes the finding of a duplicated nerve during a posterior arthroscopic procedure for the treatment of a symptomatic Os Trigonum. A 32-year-old male professional soccer player was evaluated due to pain in the posterior area of his left ankle. He started with pain in the posterior area of the ankle when he kicked the ball. He presented a negative Tinel's sign and numbness in his foot and ankle. The MRI showed two compatible nerve structures of the posterior tibial nerve considering most of all the usual diameter of the mentioned. During posterior arthroscopy exploration of the medial side and after removing the Os trigonum we could recognize two anatomical structures compatible with two nerves. An important variation of the terminal branches of the tibial nerve is observed, both in the level of their bifurcation and in the number and origins of the medial and lower calcaneal branches, with some differences in their prevalence. Based on the arthroscopic image, it's difficult to conclude whether the nerve was indeed a high bifurcation of the tibial nerve or a calcaneal branch. In relation to this and due to the size of the nerve found added to the high percentage of high bifurcation we determine that in fact is a "second" tibial nerve. Adequate knowledge of the anatomy of the joint to be treated should cover not only the most common anatomic configurations (extra-articular and intra-articular) in statistical terms but also the possible anatomic variations to avoid confusion and serious technical errors.

### RESUMO

A endoscopia da região posterior do tornozelo está se difundindo para o tratamento de um grande número de condições que costumavam ser tratadas através da cirurgia convencional incluindo as síndromes de pinçamento posterior como a produzida pelo Os Trígono ou pelo processo posterior do talo proeminente. Este caso descreve o achado da duplicação de nervo durante o procedimento de artroscopia posterior do tornozelo para o tratamento de um Os Trígono sintomático. Um jogador profissional de futebol de 32 anos de idade foi avaliado por dor na porção posterior de seu tornozelo esquerdo. O surgimento da dor na região posterior do tornozelo se deu após um chute na bola. O teste de Tinel era negativo e não havia dormência no tornozelo e pé. A RM mostrou duas estruturas compatíveis com o nervo tibial mostrando o diâmetro usual do nervo mencionado. Durante a exploração artroscópica do lado medial, depois da remoção do Os trígono pudemos reconhecer duas estruturas anatômicas compatíveis com dois nervos. Variações importantes dos ramos terminais do nervo tibial já foram identificadas a nível de sua bifurcação, no número e origem dos ramos calcaneanos medial e inferior e em suas prevalências. Baseados apenas na imagem artroscópica é difícil determinar se as estruturas observadas representavam a bifurcação alta do nervo tibial ou ramos calcaneanos. Em virtude do calibre dos nervos encontrados, determinamos que se tratava de fato de um "segundo" nervo tibial. O conhecimento adequado da anatomia da articulação a ser tratada deve cobrir não só os detalhes anatômicos mais comuns (extra e intra-articulares) em termos estatísticos mas também as possíveis variações anatômicas para evitar confusão e erros técnicos sérios.

## INTRODUCTION

Endoscopy for the posterior region of the ankle is becoming more widespread for the treatment of a large number of conditions which used to be treated with open surgery years ago including posterior impingement syndromes, like sintomatic Os trigonum and posterior prominent talar process and also osteochondral lesions located in the posterior talar region.<sup>(1-5)</sup> There are other more rare indications like calcaneal<sup>(6)</sup> and talar cysts<sup>(7)</sup> that can benefit from these procedures. This is mostly due to the significant contribution arthroscopic anatomy has meant for this particular region of the body.<sup>(8-10)</sup> During this procedure, different posterior anatomic structures can be recognized like the flexor hallucis longus tendon (FHL), which is the most important reference non ligamentous structure at the posterior region of the ankle. Because this structure delimits the working area localized lateral to this tendon. It lies in a groove between the medial and lateral tubercles of the posterior talar process. At the level of the process, the tendon enters into a fibro-osseous tunnel, which can predispose the tendon to stenosing lesions and contribute to posterior ankle impingement. If we continue viewing to the medial region, the posterior tibial neurovascular bundle should be recognized. Care should be taken to avoid iatrogenic injuries.

The distal TN with its branches is of special interest for the treatment of different pathologies but it is an structure of special interest in tarsal túnel syndrome in which the nerve should be released.

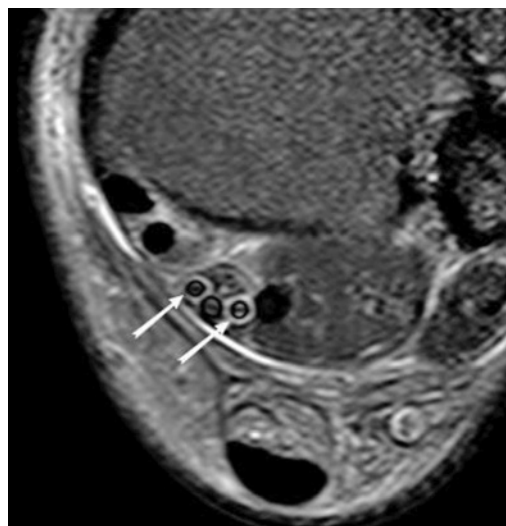
The average complication rate in ankle arthroscopy is 10.3%,<sup>(11-12)</sup> with a range of 6 to 20%.<sup>(10,13,14)</sup> The overall percentage of complications for hindfoot endoscopy compares favourably to anterior ankle arthroscopy (2.3 vs 3.5%)<sup>(12)</sup> in the recent series of Van Dijk, N. The most common complication is neurovascluar injury, presented on average 3.7% (1-27%)<sup>(14-16)</sup> and specifically hypoesthesia of the heel due to iatrogenic lesion of posterior tibial nerve's branch. We must consider this information when performing this type of procedure. This case report describes the finding of a duplicated nerve during a posterior arthroscopic procedure for the treatment of a sintomatic Os Trigonum.

## CASE REPORT

A 32-year-old male professional soccer player was evaluated due to pain in the posterior area of his left ankle (positive ankle plantar flexion test). As

antecedent he presented a moderate pain in his left ankle 60 days previous to examination after kicking a ball. The ankle range of motion was complete and he presented difuse slight swelling in the posterior area with no signs of mechanical ankle instability.

The patient had been treated with sports rest, cryotherapy, anti-inflammatory medication and a corticosteroid infiltration beginning with rehabilitation in the field in the second month. During proprioception and neuromuscular exercises and running he had not discomfort but he started with pain in the posterior area of the ankle when he kicked the ball. He presented a negative Tinel's sign and numbless in his foot and ankle. The MRI showed soft tissue edema in the posterior ankle compartment and near the Os Trigonum and two compatible nerve structures of the posterior tibial nerve considering most of all the usual diameter of the mentioned (Figure 1).

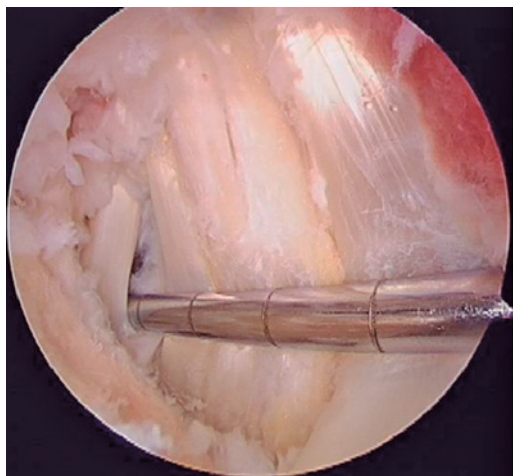


**Figure 1.** MRI. Two estructures compatible with tibial nerve (White arrows)

## Surgical technique

Posterior endoscopy. Through the 2 posteromedial and posterolateral portals described by Van Dijk<sup>(3)</sup> and after removing the soft tissue with shaver, the FHL was identified with its retinaculum undamaged. During the exploration of the medial side and after removing the Os trigonum we could recognize two anatomical structures compatible with two nerves (Figure 2).

We performed a sinovectomy with shaver for release the branches of the nerve and we opened the flexor digitoum and posterior tibial tendon sheaths.



**Figure 2.** Posterior arthroscopy. Two nerves near FHL

No hypoesthesia or anesthesia was detected after the manipulation of the nerve and its branches. The patient returned his physical activities without symptoms two months after the procedure.

## DISCUSSION

The distal part of the tibial nerve (TN) branches into the calcaneal branch (CB), the medial plantar nerve (MPN) and the lateral plantar nerve (LPN). These branches innervate the calcaneal, the medial plantar and the lateral plantar areas of the foot, respectively, and carry sensory information from those areas.<sup>(17)</sup>

There are numerous anatomic descriptions of the Posterior Tibial Nerve and its branches in the literature, but detailed quantitative data are not given anywhere. At the level of the ankle, the Tibial Nerve (TN) bifurcates into the Medial Plantar Nerve (MPN) and Lateral Plantar Nerve (LPN). This bifurcation point varies only a little among specimens, whereas a great dispersion exists in the bifurcation level of the Calcaneal Branche (CB). Most studies indicate that the tibial bifurcation is located in the tarsal tunnel in the great majority of cases.

Davis et al.<sup>(18)</sup> found that the TN divides within the tarsal tunnel, within 2 cm of the medialmalleolar-calcaneal axis (MMCA) in 16 out of 18 feet. In the remaining two feet the bifurcation took place 5 and 9cm proximal to the MMCA. Other Publications like Bareither et al. identified the bifurcation more proximally in up to 31% of the feet studied.<sup>(19)</sup>

The different anatomical anomalies of peripheral nerves occurs with various frequencies in the population.

The most widely recognized are Martin-Gruber anastomosis (MGA), accessory deep peroneal nerve (ADPN), and complete innervations of the intrinsic hand muscles by the ulnar nerve (“all ulnar hand”).<sup>(20)</sup>

Considering the origin of the division of the nerves at the lower leg and according to the descriptions of Dellon and Mackinnon,<sup>(21)</sup> a reference line (malleolar-calcaneal axis - MCA) is commonly used between the center of the medial malleolus and the medial calcaneal tuberosity.<sup>(22)</sup> A classification was prepared for the tibial nerve bifurcation, in relation to the MCA, with five subtypes based on the initial proposal of Bilge<sup>(23)</sup> adapted and expanded: type I represents that the bifurcation is proximal to the axis, but inside the tarsal tunnel; type II represents that the bifurcation occurs at the axis; type III represents that the bifurcation is distal to the axis, but inside the tarsal tunnel; type IV represents that the bifurcation is proximal to the axis, yet outside the tarsal tunnel, while type V represents that the bifurcation is distal to the axis and outside the tunnel.<sup>(6,18)</sup>

In concordance with other published articles, an important variation of the terminal branches of the tibial nerve is observed, both in the level of their bifurcation and in the number and origins of the medial and lower calcaneal branches, with some differences in their prevalence.<sup>(19,22,23)</sup> According to some authors about 10% of cases may have high bifurcations, as proximal as 14.3cm to the medial maleolus.<sup>(18,22)</sup> The comparison between articles can be seen in table 1.<sup>(18,19,21,24-27)</sup>

These findings can have important repercussions in the presentation of the symptomatology of patients with tarsal tunnel syndrome, since branches with proximal origins can present pathways on a plane superficial to the flexor retinaculum. Therefore, if they do not penetrate the tunnel they present lower propensity to compression, maintaining the sensitivity of their innervation territory. This presentation would justify some discrepancies between the clinic and electrical conductivity tests.<sup>(20)</sup>

Identification of branching patterns of the tibial nerve around the tarsal tunnel is an important issue in various clinical fields.<sup>(8-10,14,20)</sup> When performing a procedure, surgeons should be aware of branching patterns of the tibial nerve and their relative locations to avoid neural damage.<sup>(28)</sup>

Based on the arthroscopic image, it's difficult to conclude whether the nerve was indeed a high bifurcation of the tibial nerve or a calcaneal branch that was originated proximal to the MCA. In relation to this and due to the size of the nerve found added to the

**Table 1.** Comparison between articles

Authors	Year	Nº of cases	Bifurcation inside the tunnel (%)	Bifurcation proximal to the tunnel (%)	Bifurcation distal to the tunnel (%)
Horwitz <sup>(24)</sup>	1938	100.0	96.0	4.0	-
Dellon & Mackinnon <sup>(21)</sup>	1984	31.0	94.0	6.0	-
Davis & Schon <sup>(18)</sup>	1995	20.0	90.0	10.0	-
Bareither <sup>(19)</sup>	1990	126.0	69.0	31.0	-
Joshi <sup>(25)</sup>	2006	112.0	99.9	0	0.9
Fernandes <sup>(26)</sup>	2006	30.0	86.7	10.0	3.3
Torres <sup>(27)</sup>	2011	50.0	88.0	12.0	-
			89.1	10.4	2.1

high percentage of high bifurcation we determine that in fact is a “second” tibial nerve.

There is no doubt that the knowledge of the arthroscopic anatomy is, very important to avoid iatrogenic lesions. Hence, adequate knowledge of the anatomy of the joint to be treated should cover not only the most common anatomic configurations (extra-articular and intra-articular) in statistical terms but also the possible anatomic variations to avoid confusion and serious technical errors.<sup>(19)</sup>

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