

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

A Case of Bilateral Baxter's Neuropathy Secondary to Plantar Fasciitis

Matthew R.F. Jaring, MBBS, BSc (Hons), MRCS, FRCR¹, Asif Z. Khan, BSc (Hons), MBBS, MSc, MRCS², James A. Livingstone, MBBS, MD, FRCS (Tr and Orth)³, Julian Chakraverty, MBChB, BSc (Hons), DO, PG Dip, MRCS, FRCR⁴

¹ Specialty Registrar, Clinical Radiology, Department of Radiology, University Hospitals Bristol National Health Service Foundation Trust, Bristol Royal Infirmary, Bristol, United Kingdom

² Specialty Registrar, Trauma and Orthopaedic Surgery, Department of Orthopaedics, University Hospitals Bristol National Health Service Foundation Trust, Bristol Royal Infirmary, Bristol, United Kingdom

³ Consultant Orthopaedic Surgeon, Department of Orthopaedics, University Hospitals Bristol National Health Service Foundation Trust, Bristol Royal Infirmary, Bristol, United Kingdom

⁴ Consultant Radiologist, Department of Radiology, University Hospitals Bristol National Health Service Foundation Trust, Bristol Royal Infirmary, Bristol, United Kingdom



ARTICLE INFO

Level of Clinical Evidence: 4

Keywords:

abductor digiti minimi
abductor digiti quinti
Baxter's neuropathy
inferior calcaneal nerve

ABSTRACT

Heel pain is 1 of the most common presentations to the foot surgeon, and its causes are multifactorial. Baxter's neuropathy is caused by an impingement of the inferior calcaneal nerve and has been reported to be responsible for up to 20% of heel pain. The diagnostic imaging features are striking, with inflammation or atrophy of the abductor digiti minimi muscle. Multiple studies have found that the prevalence of this finding is much greater than initially thought. However, it is more unusual to find bilateral and symmetrical features. The possible causes of this condition lie along the course of the inferior calcaneal nerve. Management is focused on treating the underlying condition, with conservative therapy and steroid injection as the mainstay. Refractory cases may require surgical release. We present the case of a 56-year-old female presenting with bilateral foot pain. Imaging reveals symmetrical abductor digiti minimi atrophy associated with bilateral plantar fasciitis. These appearances are well demonstrated on both magnetic resonance imaging and ultrasound.

© 2018 by the American College of Foot and Ankle Surgeons. All rights reserved.

Heel pain is an extremely common presentation with multifactorial etiology. Baxter's neuropathy represents 1 of the more often overlooked causes and has been reported to be responsible for up to 20% of heel pain (1). Pain is related to the entrapment of the inferior calcaneal nerve, which supplies the abductor digiti minimi (ADM)—also known as the abductor digiti quinti (2). Diagnosis may be confused by the fact that 1 of its causes, plantar fasciitis, is also a common cause of heel pain. A late sequela is atrophy of the ADM, leading to the characteristic diagnostic imaging appearance described in this case report (3).

We present a case of chronic Baxter's neuropathy, which is remarkable for the bilateral and symmetrical nature of the pathology, as well as its conspicuous appearance on imaging. Despite historic cadaveric and diagnostic imaging descriptions of the inferior calcaneal nerve entrapment, to our knowledge, this is only the second documented case of a synchronous bilateral presentation.

Financial Disclosure: None reported.

Conflict of Interest: None reported.

Address correspondence to: Matthew R.F. Jaring, MRCS, FRCS, Department of Radiology, University Hospitals Bristol National Health Service Foundation Trust, Bristol Royal Infirmary, Marlborough Street, Bristol BS1 3NU, United Kingdom.

E-mail address: mjaring@outlook.com (M.R.F. Jaring).

Case Report

In March 2017, a 56-year-old female was referred by her general practitioner for the orthopedic assessment of chronic foot pain. This was not amenable to conservative management with analgesia. The pain was described as across the arches of the feet and omnipresent but exacerbated by walking. The patient had a medical history of varicose vein surgery but no chronic illness or inflammatory arthropathy.

On examination, the patient had normal gait and movement, with no medial pain on palpation. Percussion and palpation did not elicit any symptoms to suggest tibial nerve compression or tarsal tunnel syndrome. The patient had undergone nerve conduction studies that confirmed conduction abnormality in the hindfoot and showed no evidence of a large fiber peripheral neuropathy (normal tibial nerve H-reflex bilaterally). There were delayed and attenuated motor responses bilaterally in the tibial nerve. The exact location of the pathology was slightly inconclusive, as results suggested neuropathy in the region of the tarsal tunnel bilaterally; however, the neurophysiologist noted that despite this, symptoms were restricted to the soles of the feet. To clarify this, imaging of the posterior tibial nerve at the ankle was advised. The patient was referred for magnetic

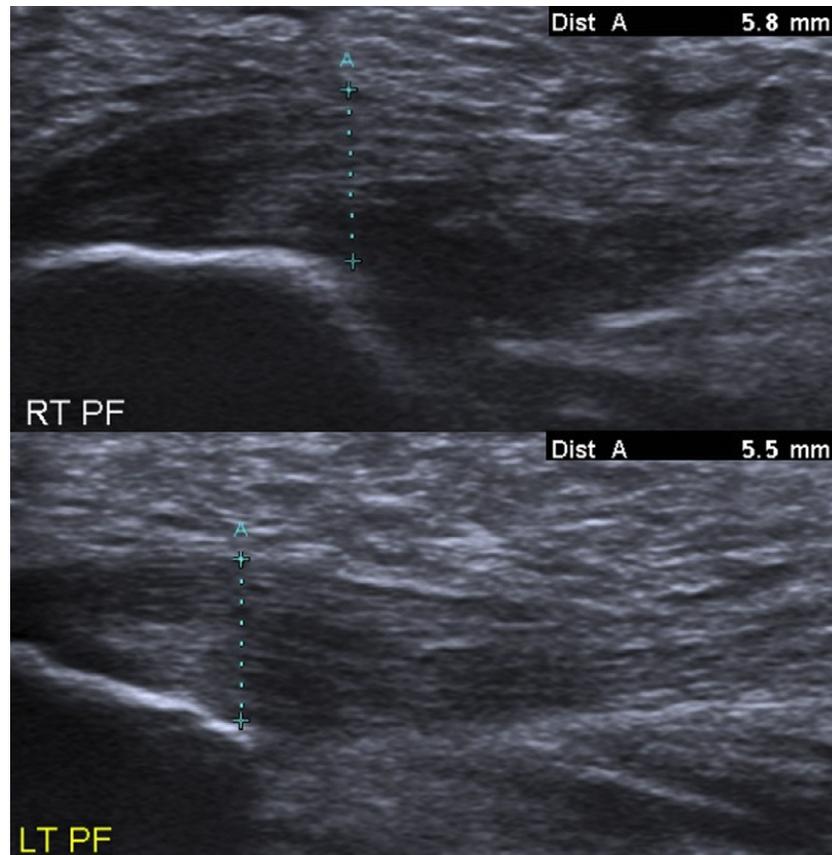


Fig. 1. Sagittal ultrasound of the right and left plantar fascia calcaneal insertion showing a thickened and echogenic plantar fascia, consistent with plantar fasciitis. *LT PF*, left plantar fascia; *RT PF*, right plantar fascia.

resonance imaging scans of the bilateral ankle, as well as for diagnostic ultrasound (US).

The US imaging revealed bilateral thickening of the plantar fascia at its calcaneal origin, measuring 5.5 mm on the right and 5.8 mm on the left (normal range <4.5 mm) (4) (Fig. 1). There was an increased echogenicity within the proximal plantar fascia, indicative of inflammation. These findings are consistent with bilateral plantar fasciitis. Atrophy can be measured on US by assessing the cross-sectional area of the muscle. Fatty infiltration can also be seen, with increased echogenicity within the muscle.

Magnetic resonance imaging showed an increased intensity on fat-suppressed imaging (short tau inversion recovery [STIR]) within the medial calcaneal tuberosity at the origin of the plantar fascia (Fig. 2) and adjacent to the proximal plantar fascia. These features relate to perifascial edema, with a degree of insertional calcaneal marrow edema, and are consistent with bilateral plantar fasciitis.

In addition, magnetic resonance imaging revealed bilateral signal abnormalities in the ADM muscles. High-intensity signal on T1-weighted imaging and a loss of signal on STIR are consistent with fatty atrophy of these muscles and were seen symmetrically. These features

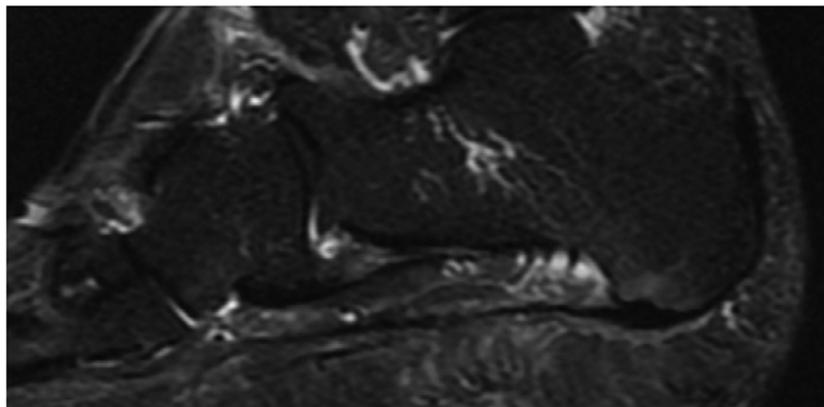


Fig. 2. Sagittal short tau inversion recovery magnetic resonance imaging of the right foot showing an increased intensity of the medial calcaneal tuberosity at the origin of the plantar fascia and adjacent to the proximal plantar fascia, which is consistent with plantar fasciitis.

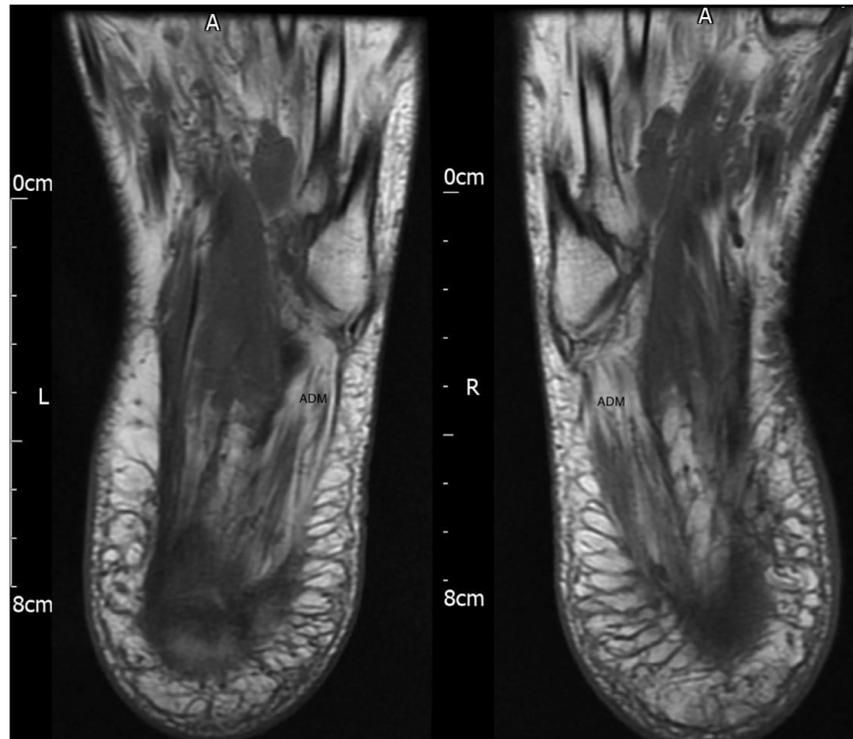


Fig. 3. Axial T1-weighted magnetic resonance imaging of both feet showing fatty atrophy of the abductor digiti minimi muscle. ADM, abductor digiti minimi; L, left; R, right.

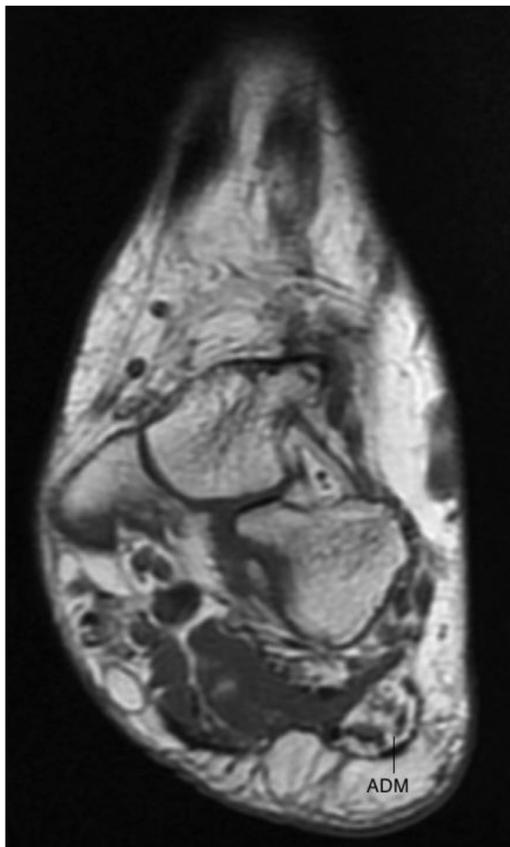


Fig. 4. Coronal T1-weighted magnetic resonance imaging of the left foot showing fatty atrophy of the abductor digiti minimi muscle, with preservation of the muscle bulk in the remaining intrinsic muscles of the foot. ADM, abductor digiti minimi.

are consistent with bilateral ADM atrophy. The rest of the muscles appeared normal, with no other pathology (Figs. 3 and 4, ADM labeled).

The presence of solitary atrophy of the ADM muscles led to the diagnosis of bilateral Baxter's neuropathy. This was supported by the combined results of US, clinical, and nerve conduction examinations.

Following the discussion on this, the patient was keen to avoid surgery or steroid injection and instead opted for lifestyle modification with orthotics and physiotherapy, with the goal of reducing nerve impingement and managing the plantar fasciitis. She was seen 9 months later (in early 2018) and reported that her bilateral symptoms were greatly improved to the point where she felt that a more invasive intervention was not required.

Discussion

The inferior calcaneal nerve is the first branch of the lateral plantar nerve, which itself is a branch of the tibial nerve formed on its exit from the tarsal tunnel. The inferior calcaneal nerve has motor branches to flexor digitorum brevis, quadratus plantae, and ADM, with sensory innervation of the calcaneal periosteum and the long plantar ligament (3). Its tendency to be involved in pathology appears to be related to its course, which allows entrapment at several sites, as it passes from its origin, just inferior to the medial malleolus, toward its terminal motor branches at ADM. In this case, the isolated nature of the atrophy of only ADM points away from the more proximal compression of the posterior tibial or lateral plantar nerves (2). Initial findings often show edema within the affected muscle (characterized by a normal or reduced intensity ADM muscle signal on T1 and a high-intensity signal on T2 or STIR), and in the long term, this has been seen to progress to atrophy and fatty replacement, with subsequent high-intensity signal on T1.

Nerve conduction studies are often carried out on patients with this pattern of symptoms; however, previous reviews have noted that, in the case of Baxter's neuropathy, these are often not helpful (5).

Retrospective studies have found that fatty atrophy of ADM is more common than thought previously. Recent studies have shown a unilateral prevalence of 6.3%; however, this study carried a risk of possible selection bias (3). The unrelated presenting complaint in many of these cases suggests that Baxter's neuropathy is often incidentally discovered rather than being causative. Bilateral presentation appears to be a very uncommon entity and is described very rarely, especially in the clear presence of bilateral plantar fasciitis.

Multiple causative factors have been identified when studying Baxter's neuropathy and subsequent ADM atrophy. There is an association with Achilles tendinosis, calcaneal spur formation, and plantar fasciitis. The latter 2 are likely owing to the proximity of the nerve to the medial calcaneal tuberosity. The condition was found to be more common in females than in males (1,3).

The management of Baxter's neuropathy can be conservative, with some patients responding to physiotherapy, orthotics, or nonsteroidal antiinflammatory drugs. When these fail, the next option is generally steroid injection. Surgical management of Baxter's neuropathy involves the release of the inferior calcaneal nerve (1).

In conclusion, the importance of this case lies in both its regularity and its rarity. Studies show an increasing realization of the prevalence of the unilateral findings of ADM atrophy, which is indicative of Baxter's neuropathy. The large prevalence of heel pain makes consideration of what has been a relatively obscure pathology vital. Conversely, in this case, the patient had the more infrequent presentation of bilateral findings, with synchronous bilateral pathology secondary to plantar fasciitis.

References

1. Chundru U, Liebeskind A, Seidelmann F, Fogel J, Franklin P, Beltran J. Plantar fasciitis and calcaneal spur formation are associated with abductor digiti minimi atrophy on MRI of the foot. *Skeletal Radiol* 2008;37:505–510.
2. Delfaut EM, Demondion X, Bieganski A, Thiron M-C, Mestdagh H, Cotten A. Imaging of foot and ankle nerve entrapment syndromes: from well-demonstrated to unfamiliar sites. *Radiographics* 2003;23:613–623.
3. Recht MP, Grooff P, Ilaslan H, Recht HS, Sferra J, Donley BG. Selective atrophy of the abductor digiti quinti: an MRI study. *Am J Roentgenol* 2007;189:W123–W127.
4. McNally EG, Shetty S. Plantar fascia: imaging diagnosis and guided treatment. *Semin Musculoskelet Radiol* 2010;14:334–343.
5. Rose B, Singh D. Inferior heel pain. *Orthopaed Trauma* 2016;30:18–23.