Case Report

Freiberg's Disease of Bilateral and Adjacent Metatarsals

Callum John Donaldson^a Ziad Harb^b Laila Hussain^c Roland Walker^c
Ali Abbasian^c

^aDepartment of Surgery, University of Cambridge, Cambridge, UK; ^bDepartment of Orthopaedic Surgery, Ashford and St Peter's Hospitals NHS Foundation Trust, Chertsey, UK; ^cDepartment of Orthopaedic Surgery, Guy's and St Thomas' NHS Foundation Trust, London, UK

Keywords

Forefoot pain · Male patient · Metatarsalgia · Second metatarsal · Third metatarsal

Abstract

Freiberg's disease is a rare condition characterized by avascular necrosis of the lesser metatarsal heads. The incidence is highest in females, and the disease is usually unilateral, affecting just a single metatarsal. In this report, we describe the first male case of Freiberg's disease involving the second and third metatarsals in both feet, with the aim of highlighting the condition as a potential cause of such forefoot pain. One year of follow-up is provided.

© 2020 The Author(s)
Published by S. Karger AG, Basel

Introduction

Freiberg's disease, first described in 1914, is characterized by avascular necrosis of the lesser metatarsal heads [1]. Many cases of Freiberg's disease are asymptomatic or resolve spontaneously before treatment is sought, and this makes estimating the prevalence of the disease challenging. As such, no quantitative estimate of the prevalence of Freiberg's disease currently exists in the literature. However, Freiberg's disease is widely regarded as a rare phenomenon [2]. The incidence is highest amongst adolescent females, although the disease can develop at any age and in either sex [1, 2]. The second metatarsal is the most commonly affected, followed by the third [3]. The disease is usually unilateral and involves just a single metatarsal [4, 5]. To our knowledge, only 1 report describing bilateral involvement of both the second and third metatarsals exists in 2 female patients aged 42 and 72 years [6]. This is, therefore, the first reported male case of Freiberg's disease in bilateral and adjacent metatarsals.

Case Report

The patient, treated between November 2015 and November 2016, provided his consent to be included in this report.

This 63-year-old male presented to clinic with a 1-year history of bilateral forefoot pain, localized to the second and third metatarsophalangeal joints (MTPJs). He reported that the pain was worse on the left foot and rated the severity as 9 out of 10 on the visual analogue scale. He was able to walk pain free for only 5 min. The patient had previously been treated at another hospital, with a 5-week course of oral antibiotics, with no effect on his symptoms. He did not report pain in any other joints.

The patient did not report any history of trauma or injury. His past medical history was, however, significant for type II diabetes, which was diagnosed at a similar time to the commencement of the forefoot pain. This was under control with metformin. The patient smoked 6 cigarettes and drank approximately 10 units of alcohol per day.

On examination, there was erythema and dorsal swelling bilaterally. He had intact medial longitudinal arches, early hallux valgus with pronation of his first toe, tight gastrocnemii and positive Silfverskiöld tests bilaterally. He had a painful range of motion of his left second MTPJ, palpable dorsal osteophytes and plantar tenderness of the second and third MTPJs bilaterally.

Plain radiographs showed sclerosis of the metatarsal shafts and flattening of the heads in his second and third metatarsal bilaterally (Fig. 1). Magnetic resonance imaging (MRI) showed bilateral second and third avascular necrosis of the metatarsal heads with high signal of the metatarsal shaft more pronounced in the second metatarsals (Fig. 2).

Orthotics, with a forefoot offloading insole and incorporated metatarsal bar to reduce the point pressures on the affected metatarsal heads, were provided but did not improve the bilateral forefoot pain. As conservative measures failed to improve symptoms, the patient underwent a left foot second and third MTPJ debridement and second and third Weil's osteotomy. Weil's osteotomy was performed using standard technique via a dorsal incision. Weil's osteotomy was preferred because the whole head was involved and collapsed, meaning that

simple debridement would not have sufficed. This is because simple debridement does not address the root cause, which is the relatively long second and third metatarsals within the anatomical cascade. Similarly, closing dorsal wedge or rotational osteotomies were also not possible because very little intact cartilage was seen on the plantar articular surface. The degree of shortening was determined by intra-operative image intensifier guidance to restore the natural metatarsal cascade (Lelièvre's parabola). A single cut was performed, taking into account the thickness of the saw blade, meaning that there was natural elevation of the head and avoidance of plantarisation. Fixation of the osteotomies was completed with Ortho Solutions™ (Maldon, Essex, United Kingdom) twist-off screws. Intra-operatively, the affected metatarsals showed typical features of degenerative articular surfaces with a necrotic metatarsal head, secondary osteophytosis and synovitis. Post-operative instructions permitted full weight bearing in a DARCO MedSurg™ Shoe (DARCO International, Huntington, WV, USA), to offload the forefoot, for 6 weeks. At 2 weeks post-operatively, the wound had healed without any complications. At 6 weeks, the patient reported that he was doing very well and was pain free, whilst radiographs revealed good bone healing. He subsequently underwent the same procedure on the right foot 6 months after the initial operation and, following the same post-operative procedure as the contralateral extremity, made a similarly favourable post-operative recovery, with no complications, good wound healing, full return to normal activities and the patient happy with his outcome (Fig. 3). Given the success of bilateral debridement and Weil's osteotomies in managing the patient's symptoms, his gastrocnemii tightness was managed with physiotherapy, typically the first-line treatment for this condition, instead of attempting a recession procedure with its inherent risks. He continued to do well and was discharged from our care 1 year after the initial operation.

Discussion

Trauma and vascular compromise are the 2 most commonly cited aetiologies [7]. The second metatarsal's relative immobility and greater length, in comparison to the other metatarsals, make it susceptible to stress during normal activity and may explain the disease's predilection for this site [8]. In a similar vein, repetitive forced dorsiflexion injuries of the metatarsal heads, inflicted by high-heeled shoes for example, may explain the higher preponderance of the disease amongst females [8]. A predisposition to vascular compromise is likely to exist in those with an anatomical variant, in which the second metatarsal artery is absent and blood supply to the metatarsal comes instead from the first and third metatarsal arteries [7]. Associations with systemic disorders, including systemic lupus erythematosus, hypercoagulability and diabetes mellitus, have also been noted [8, 9]. Muscular atrophy of the foot, secondary to neuropathy, is thought to be the pathological factor in diabetes [9].

Patients commonly present with forefoot pain, localized to the metatarsal heads and exacerbated by weight bearing [10]. The affected joint, most commonly the second MTPJ, may be swollen with limited range of movement and, in advanced cases, show features of malalignment and deformity [10]. The diagnosis can be confirmed by radiography which, as the disease progresses, will show increased joint space, flattening of the metatarsal head in the anteroposterior diameter, bony fragmentation and, finally, complete degeneration of the joint

[11]. In early stages of the disease, plain films are occasionally normal, but MRI can be used to demonstrate hypo-intensity of the metatarsal head, bone oedema as well as fragmentation and collapse, whilst bone scans may reveal a photopenic core with a hyperactive cortex [11].

In 1967, Smillie [12] described a classification of Freiberg's disease based on the intra-operative appearance of affected metatarsals; however, all but the first stage are also appreciable radiographically (Table 1).

Conservative management should be employed first line in all cases of Freiberg's disease and includes oral analgesia, rest, orthotics and immobilization [8]. Conservative measures aim to control pain as well as to offload the affected metatarsals and prevent progression to later stages of the disease in which anatomical restoration is no longer achievable. These have proven particularly effective in Smillie disease stages 1–3 [13]. In cases where these measures are ineffective, operative treatment may be employed. A wide variety of surgical techniques have been utilized, including joint debridement, micro-fracture, dorsal wedge osteotomy, metatarsal shortening osteotomy, metatarsal head resection and arthroplasty [14]. Whilst successes have been reported for all of the above, the evidence is currently insufficient to recommend any one procedure as the optimal technique [13, 14]. However, generally speaking, joint-preserving procedures have been shown to produce superior outcomes to joint-destructive procedures, and the latter should be reserved for Smillie disease stages 4 and 5 [13, 15]. Following promising demonstration of the technique in recent case series, osteochondral autograft transplantation may also develop a role in the operative management of Freiberg's disease [16, 17].

We report this case report for its uniqueness and for its educational value in understanding the plethora of causes of forefoot pain. Only 1 report of Freiberg's disease affecting bilateral and adjacent metatarsals has been published previously and concerned 2 female patients. This is the first time that the same extensive pattern of disease has been described in the less commonly affected male sex.

Statement of Ethics

The subject provided their informed consent for their case and associated images to be published.

Disclosure Statement

The authors have no conflicts of interest to declare.

Funding Sources

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Author Contributions

Callum J. Donaldson, Ziad Harb, Laila Hussain, Roland Walker and Ali Abbasian made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content; and final approval of the version to be published; and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References

- Freiberg A. Infraction of the second metatarsal bone, a typical injury. *Surg Gynecol Obstet.* 1914;19:191–3.
- Katcherian DA. Treatment of Freiberg's disease. *Orthop Clin North Am.* 1994 Jan;25(1):69–81.
- Gauthier G, Elbaz R. Freiberg's infraction: a subchondral bone fatigue fracture. A new surgical treatment. *Clin Orthop Relat Res.* 1979 Jul-Aug;(142):93–5.
- Mandell GA, Harcke HT. Scintigraphic manifestations of infraction of the second metatarsal (Freiberg's disease). *J Nucl Med.* 1987 Feb;28(2):249–51.
- Norton M, Eyres KS. Acute Freiberg's disease in adjacent metatarsals. *Foot.* 1998;8(4):230–2.
- Ozkan NK, Ozkan K, Ugutmen E, Eceviz E, Ozkan FU. Bilateral Freiberg's disease in adjacent metatarsals. *Eur J Orthop Surg Traumatol.* 2008;18(8):599–601.
- Cerrato RA. Freiberg's disease. *Foot Ankle Clin.* 2011 Dec;16(4):647–58.
- Carmont MR, Rees RJ, Blundell CM. Current concepts review: Freiberg's disease. *Foot Ankle Int.* 2009 Feb;30(2):167–76.
- Nguyen VD, Keh RA, Daehler RW. Freiberg's disease in diabetes mellitus. *Skeletal Radiol.* 1991;20(6):425–8.
- Shane A, Reeves C, Wobst G, Thurston P. Second metatarsophalangeal joint pathology and freiberg disease. *Clin Podiatr Med Surg.* 2013 Jul;30(3):313–25.
- Talusan PG, Diaz-Collado PJ, Reach JS Jr. Freiberg's infraction: diagnosis and treatment. *Foot Ankle Spec.* 2014 Feb;7(1):52–6.
- Smillie IS. Treatment of Freiberg's infraction. *Proc R Soc Med.* 1967 Jan;60(1):29–31.
- Seybold JD, Zide JR. Treatment of Freiberg Disease. *Foot Ankle Clin.* 2018 Mar;23(1):157–69.
- Schade VL. Surgical Management of Freiberg's Infraction: A Systematic Review. *Foot Ankle Spec.* 2015 Dec;8(6):498–519.
- Trnka HJ, Lara JS. Freiberg's infraction: surgical options. *Foot Ankle Clin.* 2019 Dec;24(4):669–76.
- Miyamoto W, Takao M, Miki S, Kawano H. Midterm clinical results of osteochondral autograft transplantation for advanced stage Freiberg disease. *Int Orthop.* 2016 May;40(5):959–64.
- Ishimatsu T, Yoshimura I, Kanazawa K, Hagio T, Yamamoto T. Return to sporting activity after osteochondral autograft transplantation for Freiberg disease in young athletes. *Arch Orthop Trauma Surg.* 2017 Jul;137(7):959–65.

Fig. 1. Left weight-bearing antero-posterior (a), right weight-bearing antero-posterior (b), left lateral (c) and right lateral (d) pre-operative radiographs showing bilateral sclerosis of the second and third metatarsals and bilateral flattening of the second and third metatarsal heads.

Fig. 2. Left postero-anterior (a), right postero-anterior (b), left coronal (c) and right coronal (d) MRI images showing bilateral avascular necrosis of the second and third metatarsal heads, with high signal of the metatarsal shaft more pronounced in the second metatarsals bilaterally (appreciable in c, d).

Fig. 3. Left weight-bearing antero-posterior (a), right weight-bearing antero-posterior (b), left lateral (c) and right lateral (d) 6-week post-operative radiographs showing good bone healing.

Table 1. The Smillie staging system for Freiberg's disease

Smillie stage	Description
1	A fissure fracture develops in the ischaemic metatarsal epiphysis
2	Absorption of bone has taken place, and the central portion of the metatarsal head begins to sink into itself, altering the contour of the articular surface
3	Further absorption has taken place, and the central portion of the metatarsal has sunk into itself leaving projections on either side; the plantar articular cartilage remains intact
4	The plantar hinge of articular cartilage has given way and peripheral projections have fractured to form loose bodies; anatomical restoration is no longer possible
5	The final stage shows arthrosis with marked flattening and deformity of the metatarsal head
Information from Smillie [12].	