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Freiberg's Disease: A Case Report And Literature Review

Dr Omar Habib Allah, Dr Ayoub Mikou, Pr Mohammed Bensaka, Pr Hatim Abid, Pr Mohammed Elidrissi, Pr Abdelmajid Elmrini

Service de Traumatologie-Orthopédie B4
CHU Hassan II – Fez, Morocco
Corresponding author: Dr Omar Habib Allah
Email: omarhabiballah2017@gmail.com

Abstract: *Freiberg's disease is a rare avascular osteonecrosis of the central metatarsal heads, predominantly affecting the second metatarsal. It typically occurs in adolescent females, though adult cases are well documented. We report a 28-year-old male who presented with progressive metatarsalgia and a stiff, painful second metatarsophalangeal (MTP) joint. Radiographic evaluation revealed complete flattening of the second metatarsal head with intra-articular loose bodies and established MTP osteoarthritis, classified as Smilie Stage 5. The patient underwent surgical joint debridement and cheilectomy. At six-month follow-up, the AOFAS score improved from 52 to 86, with complete pain resolution and return to full weight-bearing. This case highlights the importance of early diagnosis and demonstrates that joint debridement yields excellent results even in advanced-stage disease.*

Keywords—Freiberg's disease; avascular necrosis; metatarsal osteonecrosis; metatarsalgia; joint debridement; AOFAS score; Smilie classification

1. INTRODUCTION

Freiberg's disease, first described by Alfred Freiberg in 1914, is a relatively rare avascular osteonecrosis of the central metatarsal heads. The second metatarsal is most frequently involved (68% of cases), followed by the third and fourth [1,2]. Köhler provided the first complete clinical and radiological description in 1920, and Smilie established the five-stage radiological classification that remains the standard reference today [3,4].

The condition predominantly affects adolescent females, though it also occurs in adults, where it may resemble a fatigue fracture variant. Bilateral involvement is rare (approximately 7%). Predisposing factors include repetitive microtrauma, central metatarsal overloading, a long second metatarsal, first ray insufficiency (hallux valgus, hypermobility), and gastrocnemius tightness. Vascular theories propose arterial spasm at the joint capsule level compromising epiphyseal perfusion [5].

Left untreated, the disease progresses toward necrotic fragment sequestration and progressive MTP osteoarthritis. Management ranges from conservative measures in early stages to surgical debridement, Gauthier dorsal osteotomy, osteochondral grafting, or arthroplasty in advanced cases [16]. We report a Smilie Stage 5 case treated by joint debridement and review the current literature on diagnosis and management.

2. CASE REPORT

A 28-year-old male presented with a several-month history of progressive right forefoot pain occurring exclusively on weight-bearing and worsening with ambulation, causing a progressive reduction in walking perimeter. He denied prior foot trauma, relevant medical or surgical history, and family history of arthropathy or metabolic bone disease.

Physical examination revealed swelling over the second metatarsal head. The second MTP joint was stiff and painful on both active and passive motion. Provocation maneuvers (dorsal head compression, axial MTP loading, and forced dorsiflexion) reproduced symptoms. Pre-operative AOFAS forefoot score was 52/100.

Weight-bearing anteroposterior radiographs demonstrated complete flattening of the second metatarsal head, multiple intra-articular loose bodies, and established MTP osteoarthritis (Fig. 1), consistent with Smilie Stage 5. No first ray insufficiency or hallux valgus was identified.

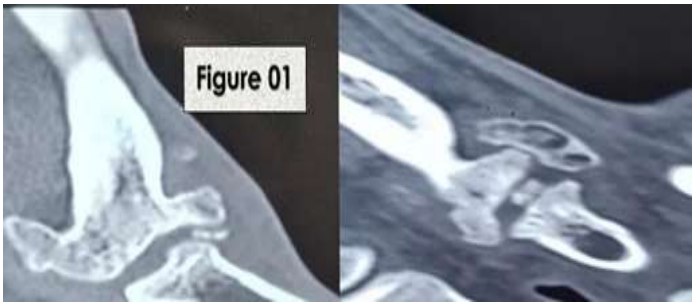

Fig. 1. *Pre-operative radiograph showing complete flattening of the 2nd metatarsal head, intra-articular loose bodies, and MTP osteoarthritis — Smilie Stage 5.*

Under spinal anesthesia with a thigh tourniquet, a dorsal longitudinal approach was performed over the second ray. Following retraction of the extensor tendons and neurovascular bundles, the MTP capsule was opened in the ray axis. Plantar flexion of the toe exposed the metatarsal head. All intra-articular loose bodies were removed and

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cheilectomy performed to restore articular sphericity (Figs. 2–3). The joint was copiously irrigated and the capsule repaired.

Fig. 2. *Intraoperative view: retrieval of intra-articular loose bodies and cheilectomy of the 2nd metatarsal head to restore articular sphericity*

Fig. 3. *Cheilectomy completed: restored articular sphericity of the 2nd metatarsal head.*

Post-operatively, protected weight-bearing in a rigid-soled shoe was permitted immediately for four weeks. Wound review at three weeks confirmed satisfactory healing. At six-month follow-up, the patient reported complete pain resolution and returned to full unrestricted weight-bearing. The AOFAS forefoot score improved from 52 to 86/100.

3. Discussion

3.1 Classification

The Smilie classification (1967) provides the universally accepted staging framework and guides treatment selection (Table 1). It describes five progressive radiological stages, from a subchondral fissure with no radiological change (Stage 1) to complete metatarsal head destruction with MTP osteoarthritis (Stage 5) [4].

Table 1: Smilie Classification of Freiberg's Disease (1967)

Stage	Histological Findings	Radiological Appearance
1	Cartilage fissure; no bone change	No radiological change
2	Cartilage fissure; soft avascular bone	Central depression of metatarsal head
3	Cartilage destruction; plantar head intact	Head flattening; joint space widening
4	Entire head avascular incl. plantar aspect	Intra-articular loose bodies; head fracture
5	Complete head destruction	Complete flattening; MTP osteoarthritis

3.2 Diagnosis

The clinical presentation evolves with stage. Early disease presents as gradual weight-bearing metatarsalgia relieved at rest, with normal joint mobility. Progressive disease brings increasing swelling, stiffness, and painful motion. At the terminal stage, MTP joint deformity, toe malalignment, and severely restricted motion dominate [5].

Weight-bearing standard radiographs are the cornerstone of diagnosis. In early stages, radiological findings lag behind symptoms; MRI is then essential, demonstrating T2 hypersignal and relative T1 hyposignal at the metatarsal head [5]. In advanced stages, plain radiographs are pathognomonic. CT scanning has limited utility, though it can quantify necrotic surface area [6]. Notably, some patients remain completely asymptomatic until the arthritic stage, with advanced disease discovered incidentally.

3.3 Differential Diagnosis

The differential diagnosis includes second ray syndrome, metatarsal stress fracture, Morton's neuroma, intermetatarsal bursitis, rheumatoid or septic arthritis, crystal arthropathy, and bone tumors. First ray insufficiency is frequently associated and must be identified, as concurrent correction may be required to address underlying metatarsal overloading [5].

3.4 Management

Conservative treatment (analgesics, anti-inflammatory agents, intra-articular corticosteroid injections, retrocapital orthotic insoles, and appropriate footwear) is first-line for Stages 1 and 2. These measures are purely symptomatic but may be sufficient to control pain and halt progression in selected patients [5,7].

When conservative treatment fails, or in advanced stages, surgery is indicated. Joint debridement and cheilectomy (originally described by Freiberg himself) aims to remove loose bodies, smooth irregular articular surfaces, and restore metatarsal head sphericity. Some surgeons supplement this with subchondral microfracture drilling to recruit fibrocartilaginous healing [5,8]. A recent evidence-based treatment algorithm proposed by Yoshimura et al. (2024) confirms that joint debridement remains a valid option at any stage of the disease, supported by consistent improvement in clinical outcomes across multiple series [16].

The Gauthier dorsal closing-wedge osteotomy (1973, refined 1979) remains one of the most reliable procedures for Stages 2–4. By resecting the necrotic dorsal portion and rotating the intact plantar cartilage into the functional weight-bearing zone, it reconstitutes a viable articular surface. Gauthier et al. reported 52 good-to-excellent outcomes in 53 cases [9]. Edmondson et al. achieved AOFAS improvement from 51.6 to 87.6 with a modified Weil osteotomy in 17 patients [10]. Kooner et al. (2023) further supported this approach in a 5-year follow-up pilot series of 12 patients with advanced Freiberg's disease, reporting consistently good-to-excellent AOFAS outcomes with a modified Weil osteotomy and few complications [17]. Complications of osteotomy include floating-toe deformity, transfer metatarsalgia, and fixation failure.

For Stage 5 disease, silicone arthroplasty (Gauthier prosthesis) or newer pyrocarbon spacers are the theoretical standard, with long-term risks including prosthetic fracture and silicone synovitis. Osteochondral autograft transplantation has shown encouraging early results for Stages 3–4 but series remain small [11,12]. More recently, Rajeev et al. (2024) reported a novel technique using Autologous Matrix-Induced Chondrogenesis (AMIC) combined with bone grafting and cheilectomy in bilateral Freiberg's disease, achieving excellent functional and radiological outcomes with AOFAS improvement from 44 to 93 at final follow-up, suggesting a promising role for biological cartilage regeneration strategies in younger patients [18].

In our case, despite Smilie Stage 5, we performed joint debridement as the primary surgical intervention. This is supported by Viladot et al. (2019), who reported significant clinical improvement after debridement and microfracture in late-stage disease [13], and by Kilic et al., who found no significant difference in AOFAS outcomes at 22 months between debridement/microfracture and dorsiflexion osteotomy in Stage 4–5 disease (AOFAS: 92 vs. 90.6) [8]. Our result (AOFAS improvement from 52 to 86) supports debridement as a valid, less-invasive first-line option at Stage 5, with arthroplasty reserved for failures.

4. Conclusion

Freiberg's disease is a rare metatarsal osteonecrosis that remains underrecognized, particularly in early stages. Prognosis is directly linked to the timeliness of diagnosis and intervention. While conservative measures suffice in early-stage disease, surgery is required in advanced cases. Joint debridement, even at Smilie Stage 5, can yield excellent functional results and should be considered a valid first-line surgical option before arthroplasty. Routine AOFAS scoring is recommended for objective outcome monitoring.

5. Acknowledgment

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