

# 30

## Freiberg's Disease

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Infracture of the second metatarsal bone was first described by Cincinnati surgeon Albert Freiberg in 1914.<sup>1</sup> In much of the English-speaking world the condition retains his name, although following a later report in 1924, on the continent of Europe it is referred to as Kohler's second disease.<sup>2</sup> Since then, the medical literature has contained few reports on the disease although there remains much controversy about its etiology and treatment.

Freiberg's disease is generally agreed to represent an avascular necrosis of the metatarsal head. Although recognized as primarily a disorder of the second metatarsal, it has been reported to affect the other metatarsals, but rarely the first.<sup>3</sup> The pathologic process characteristically begins on the dorsal surface of the metatarsal head, and Gauthier<sup>4</sup> described the disease evolution in terms of five stages: stage 0, a subchondral bone marrow fracture with normal radiographic appearances; stage 1, osteonecrosis without deformation; stage 2, deformation caused by subchondral bone collapse; stage 3, cartilaginous tearing and thus gradual detachment of the segment of abnormal bone; and stage 4, arthrosis of the joint.

Although it is reported in boys,<sup>5</sup> this is predominantly a condition affecting teenage girls. Pain, both at rest and on exercise, is the predominant clinical feature, although the patients often also complain of local swelling and tenderness that make the wearing of fashionable shoes difficult. The diagnosis is made by a combination of clinical suspicion and plain films. The radiographic appearance is typical with flattening of the subchondral bone of the metatarsal head progressing to increased bone density, fragmentation, and intra-articular loose body formation (Fig. 30-1). According to Hoskinson,<sup>5</sup> the radiographic projection

that most reliably demonstrates the early lesion is a 45° oblique of the forefoot.

### ETIOLOGY

The etiology of the condition is not very clear. According to Crock,<sup>6</sup> the metatarsal head is penetrated by radial arteries from either side that unite to form a centrally placed arterial network in the bone from which branches are given off to the subchondral area. The metatarsal head, like the femoral head, the capitulum, and the scaphoid, would seem to be particularly susceptible to avascular necrosis. Its vulnerability, like these other sites, presumably occurs because the subchondral bone is compromised by being enclosed as it is by a convex surface of avascular hyaline cartilage. Further, until the age of 17 to 20 years when the metatarsal epiphysis fuses,<sup>7</sup> the subchondral bone circulation may be further isolated by the presence of the growth plate. What predisposes the head to the development of avascular necrosis is uncertain although certain risk factors have been reported.

### TRAUMA

In Freiberg's original report of six patients, three gave a definite history of trauma, leading him to implicate trauma as being of prime importance in the development of the condition. In 1926, however, he revised this viewpoint acknowledging that "simple trauma was not a satisfying explanation of the clinical and roentgenographic phenomena."<sup>8</sup> Although this view was supported by Kohler,<sup>2</sup> authors have since reverted to a



**Fig. 30-1.** Anteroposterior radiograph showing typical appearance of Freiberg's disease involving the third metatarsal head.

traumatic etiology either as an acute event or, as Smilie<sup>9</sup> postulated, the result of repeated minor trauma. To investigate this further, Braddock<sup>10</sup> studied the effect of axially applied forces on cadaveric articulated phalanges and metatarsals from patients of different ages. He noted that the phalanx fractured in all the specimens except those two in which the stage of epiphyseal maturation corresponded closely to that

seen in early Freiberg's disease. He thus was able to conclude that there is a period of development during which the metatarsal head is particularly sensitive to trauma, resulting in the development of Freiberg's disease. In a series of 33 cases reported by Stanley et al.,<sup>11</sup> only 5 patients (15 percent), all of whom were girls, gave a definite history of trauma. It might be argued that if trauma were an important factor, the condition would occur more commonly in boys who are much more likely to injure themselves playing ball sports, and this clearly is not the case.

### METATARSAL LENGTH AND MOBILITY

It has not gone unnoticed by previous authors that the metatarsal that is most commonly affected is both the longest and least mobile. Gauthier<sup>4</sup> noted that this predisposed it to repeated traumatic stresses. However, in his series of 88 cases the longest metatarsal was affected in only 28 (32 percent) of cases. This was in marked contrast to the experience of Stanley et al.,<sup>11</sup> who measured the metatarsal lengths in both feet of 33 patients who had unilateral Freiberg's disease. The second metatarsal was the longest in 31 (94 percent) of cases and was the seat of the pathology in 30 (91 percent), the remaining 3 cases being Freiberg's disease of the third metatarsal head. There was however no significant difference between the lengths of the metatarsals of the affected feet and the unaffected feet, and thus while there is no doubting that the disease process has a predilection for the second metatarsal, which also happens to be the longest, there is no firm evidence to correlate this with the development of the disease process.

### PLANTAR PRESSURE

Betts et al.<sup>12</sup> have investigated the importance of local plantar pressure in the development of the disorder. Using the Dynamic Pedobarograph they showed that in only 15 percent of their cases was there evidence of abnormally high pressure under the affected metatarsal head. In addition they reported no differences in pressure distribution between the affected and unaffected feet, concluding that there was little evidence to

support the theory that Freiberg's disease was related to increased plantar pressures during walking.

## TREATMENT

Conservative therapy is said to be adequate in most cases. This may take the form of rest, crutches, and even a plaster cast support during the acute phase of symptoms. Once the acute symptoms have subsided, an orthosis in the form of a metatarsal bar support affords a degree of comfort and support.

If conservative therapy fails, a number of surgical techniques have been described that either attempt to modify the disease process or to salvage the situation once the metatarsal phalangeal joint develops signs of degenerate change (Table 30-1 and Fig. 30-2).

In his original series, Freiberg<sup>1</sup> stressed the significance of the presence of loose bodies in the joint, stating that they may be the reason for a failure of conservative treatment. He performed arthrotomies on two of the three patients with intra-articular loose bodies with an excellent relief of symptoms. Hoskinson<sup>5</sup> agreed with this approach although Trott<sup>13</sup> cautioned that it did not relieve the symptoms in all cases, and Stanley et al.<sup>14</sup> found that the presence of loose bodies was not an important predictor of final outcome whatever form of treatment the patient underwent.

Smillie<sup>9</sup> proposed a technique of exploring the metatarsophalangeal joint, elevating the depressed segment of metatarsal head, the buttressing the repair with cancellous bone graft. His procedure was indicated so long as the depressed fragment remained attached by a rim of hyaline cartilage, and although his results demonstrated almost perfect restoration of the articular surface he makes no comment as to the functional outcome of these cases.

Gauthier<sup>4</sup> recommended a similar philosophy of reconstructing the metatarsal head. Based on his obser-



**Fig. 30-2.** Same patient as in Figure 30-1 treated by metatarsal osteotomy.

**Table 30-1.** Surgical Treatment of Freiberg's Disease

Excision of loose bodies (Freiberg)
Elevation of depressed metatarsal head (Smillie)
Dorsiflexion osteotomy of metatarsal head (Gauthier)
Metatarsal shortening osteotomy (Smith)
Excision base of proximal phalanx (Trott)
Metatarsal head excision (Giannestras)

vation that the lesion was situated on the plantar aspect of the metatarsal head, he performed a dorsiflexion osteotomy of the metatarsal head excising the abnormal segment; 52 of his 53 cases obtained a good result with this procedure. However, in common with Smillie's aforementioned technique it may be a technically difficult procedure that may further damage the already compromised metatarsal head.

The policy on our unit has been to offer surgery to all those patients receiving no lasting benefit from a 6-

month trial of conservative therapy. A shortening osteotomy of the metatarsal is then performed, excising approximately 4 mm the metatarsal neck.<sup>15</sup> The osteotomy is stabilized by a small T-shaped plate, and the patient is immobilized in a below-knee plaster cast for 4 weeks. Of the 18 patients treated in this way, all but 1 were satisfied with the outcome. Further, in 3 cases we have seen apparent remodeling of the metatarsal head and improved congruity with the proximal phalanx following surgery (Fig. 30-3). The rationale for this



**Fig. 30-3.** Radiograph showing remodeling of the third metatarsal head after removal of the plate.

approach is that it decompresses the joint allowing repair of the subchondral bone; it does not involve an arthrotomy, and therefore the potential to do further damage to the joint is minimized; and it is a technically simple procedure.

It is clear that the disease process may progress to such an extent that such reconstructive procedures are inappropriate. In this situation, Trott's<sup>13</sup> technique of partial resection of the proximal phalanx with syndactylization of the second to the third toe may be appropriate. The disadvantage of this procedure, at least in theory, is that surgery is directed toward normal anatomy and does not address the underlying pathologic process. Despite this, Trott claims that the procedure provides relief of symptoms and a reasonable cosmetic result.

Giannestras<sup>16</sup> suggested that metatarsal head resection was appropriate for severe disease. Although we have no experience of this technique, we feel that there is a risk such surgery will result in load transference and pain under the adjacent metatarsals. In addition, Hoskinson<sup>5</sup> reported unsatisfactory results with this procedure.

## PROGNOSIS

Little is known of the long-term outcome of patients with Freiberg's disease, irrespective of method of treatment. Patients are rarely seen in adult orthopedic clinics, suggesting that symptoms resolve with time. Hoskinson's series<sup>5</sup> of 28 patients reviewed for a mean of 12 years following diagnosis is the longest in the literature. Of the 16 patients who had been treated conservatively, 11 remained asymptomatic with only 2 complaining of persistent aching. The remaining 12 patients had been treated by a variety of surgical methods, and 8 of them continued to complain of troublesome residual symptoms. In our series of 30 patients, with a mean follow-up of 7 years,<sup>17</sup> the patients were initially treated conservatively followed by a shortening osteotomy if they were still symptomatic 6 months later. Of the conservatively treated group 58 percent of patients described their pain as less than at the time of presentation, 33 percent said it was the same, and 9 percent said it was worse. Those patients who required surgery fared better, with 89% saying their pain was better, 11% the same, and no patients saying their

**Table 30-2.** Long-Term Results of Conservative and Surgical Treatment

Treatment	Symptoms Compared to Presentation (%)		
	Better	Same	Worse
Conservative	58	33	9
Surgical	89	11	0

(From Kreibich et al.,<sup>7</sup>)

pain was worse than on presentation (Table 30-2). While the two groups are not comparable it is interesting to note that those patients whose symptoms were initially bad enough to require surgery were actually less symptomatic than those treated purely conservatively. However, it must be added that there is a group of patients in whom the disorder escapes the attention of the orthopedic surgeon until the foot may be radiographed for a totally different reason.

There is still much to be learned about the etiology and treatment of this condition. When several different operations are described for the treatment of a disorder, it is often a sign that the results have been unsatisfactory. Because the condition is relatively rare, different forms of treatment have never been subjected to a prospective randomized trial. In addition, the timing of surgery may be vital. Repair and remodeling of the metatarsal head undoubtedly occurs in some patients, and there may be a crucial period in the progression of the disease when surgery would be more likely to be successful.

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