Evaluation of treatment of freiberg disease by debridement and metatarsal head resection

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Introduction
Freiberg disease is an ischemic form of necrosis of the head of metatarsals, mainly the second; it is less common in the third and fourth. Affection of the head of the first and fifth is rare. Many factors are responsible for Freiberg disease, including stress overloading, microfractures, vascular impairment, and constitutional etiologies. The disease was classified by Smillie into five stages based on the radiological findings.
Patients and methods
Between December 2011 and June 2018 at the Misr University for Science and Technology hospital, 20 patients with late stages of Freiberg disease, stage IV and V according to Smillie classification, underwent debridement and resection of the affected head. Diagnosis is done by clinical and radiological examination, and all patients were categorized. The age was from 20 to 50 years, with an average of 32.6±8.5 years. The right side was affected in 14 patients, whereas the left side was affected in six patients. According to Smillie classification, nine cases were class IV and 11 cases were class V. All patients were followed up for Kitaoka's items.
Results
All patients were improved regarding pain and function, and no cases with severe or constant pain, or limited daily or recreational activities were reported. No cases used especial shoes or brace at the final follow-up. Infection was not reported in this study. The final score improved in all cases from 52±14 (range: 29–69) to 89±7 (range: 80–100).
Conclusion
Metatarsal head resection after debridement is an effective and easy procedure for treatment of late stages of Freiberg disease with no hardware and allows early weight bearing and fast pain relief.

Keywords:
excision, Freiberg disease, resection

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Introduction

Freiberg disease is an ischemic form of necrosis of the head of metatarsals, mainly the second; it is less common in the third or fourth. Affection of the first or fifth metatarsal heads is rare [1].

It is noticed in patients with shorter first metatarsal than the second, which causes more load concentration on the head of the second metatarsal. Repeated cyclic loading during weight bearing causes impairment of the blood supply, which causes more progression of the disease [2,3].

Many factors are responsible for Freiberg disease, including stress overloading, micro-fractures, vascular impairment and constitutional etiologies as hormonal abnormalities, growth disturbances, and family history. Moreover, the less mobility of the second metatarsal leads to more load concentration and more liability to Freiberg disease [4,5].

The dominant foot is noticed to be more affected. Females to males ratio is 5 : 1. Bilateral affection was reported [6].

The disease causes anterior metatarsalgia with pain over the metatarsal head, swelling, stiffness, crepitations, and decreased range of motion of the metatarsophalangeal joint.

The disease was classified by Smillie into five stages based on radiological findings [7]. The treatment is usually conservative in stages I and II, by analgesics, orthotics, and shoe modifications. For advanced stages, numerous surgical techniques were advocated. The target of the surgical procedures is to decrease the load on the metatarsophalangeal joint whether by

osteotomies to direct the cartilage degeneration occurring in the late stages of the disease, debridement, resection, or arthroplasties [8].

Patients and methods

From December 2011 to June 2018 in Misr University for Science and Technology hospital, 20 patients with late stages of Freiberg disease, stage IV and V according to Smillie classification, underwent resection of the affected head after joint debridement. The study was approved by the institutional ethics committee in the department of orthopedics, Faculty of medicine, Misr University for science and technology and a consent for each patient was signed.

Inclusion criteria

The following were the inclusion criteria:

(1) Age between 20 and 50 years, complaining of anterior metatarsalgia and pain over the metatarsal head during weight bearing.
(2) Smillie types IV and V.
(3) Failed conservative measures.

Exclusion criteria

The following were the inclusion criteria:

(1) Patients with other foot pathology.
(2) Diabetics or patients with peripheral vascular disease.

Diagnosis is based on clinical and radiological examination. All patients were categorized according to Smillie classification. The age is between 20 and 50 years, with an average of 32.6±8.5 years. The right side was affected in 14 patients, whereas the left side was affected in six patients. According to Smillie classification, nine cases were type IV and 11 cases were type V.

All cases were preoperatively subjected to an evaluation by the lesser metatarsophalangeal interphalangeal scale by Kitaoka *et al.* [9]. The preoperative score ranged between 29 and 69, with an average of 52.

The follow-up period is between 8 months and 3 years.

Although Freiberg disease may affect the second, third, or fourth metatarsal heads, all cases in this study were affected in the second metatarsal head (Figs 1, 2).

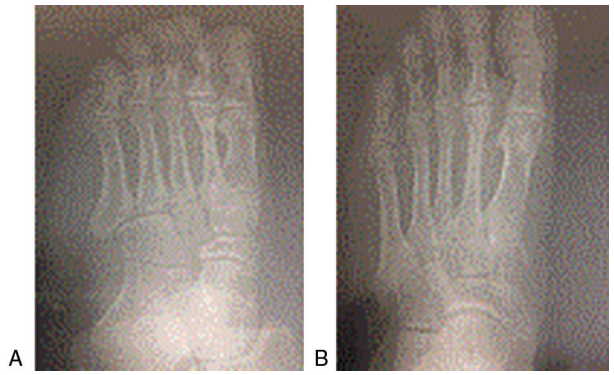
Operative technique

All surgeries were conducted under anesthesia, either spinal or general. The supine position was used in all cases. A tourniquet was applied in all cases. A dorsal midline skin incision about 4 cm in length was centered over the metatarsophalangeal joint (Fig. 2). The extensor tendons longus and brevis all were retracted to the lateral side. The capsule was incised and opened for exposure of the joint as well as the head, distal shaft, and the articular surface of the proximal phalanx (Fig. 3). Joint debridement is performed with osteotomy, along with head resection and removal of any bone fragments (Figs 4–6).

Then, the capsule, the subcutaneous tissue, and skin were closed. An extended back slab was used in all cases for 2 weeks till removal of the stitches. Weight bearing was allowed after 2 weeks.

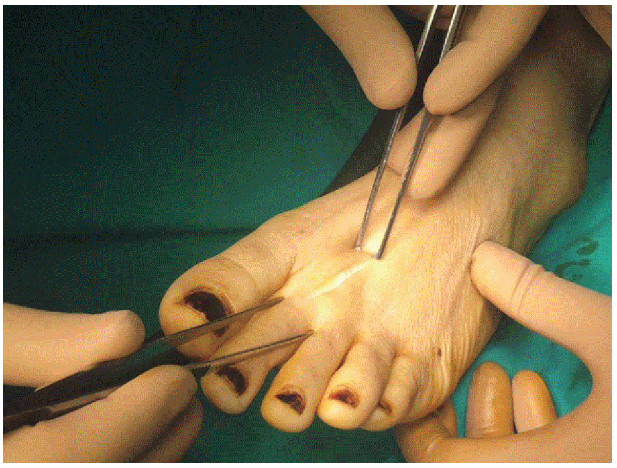
All patients were followed up according to Kitaoka's scoring system, which includes pain, function, footwear requirements, MTP joint motions, IP joint motion, stability and alignment, and recovery to normal activity and function.

Figure 1



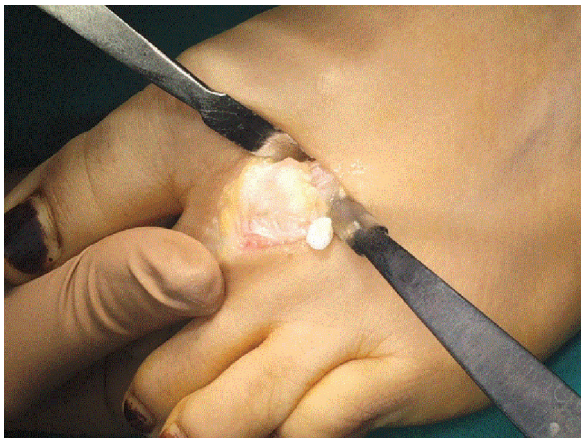
(a, b) An oblique and anterioposterior radiographic views showing Freiberg disease in the second metatarsal head.

Figure 2



Skin incision.

Figure 3



Exposure of the head.

Figure 4

Osteotomy of the head.

Figure 5

Head resection.

Figure 6

(a, b) An oblique and anterioposterior radiographic views after excision of the head.

Results

Statistical methods

Data description is by using IBM SPSS Statistics version 23 (IBM Corp., Armonk, New York, USA). Numerical data were represented as mean and standard deviation. Qualitative data were represented as frequency and percentage. Fisher's exact is for examination of the relation between qualitative variables. For quantitative data, comparison between two groups was done by the use of Mann–Whitney test. Spearman's ρ method is to test correlation between numerical variables. All tests were two tailed. A P value less than 0.05 was considered significant.

Table 1 Correlation between the age, sex, side, Smillie type, and the postoperative score

Data		*P* value
Age	Correlation coefficient=0.170	0.473
	Postoperative score (mean±SD)	
Sex		
Male	86±8	0.178
Female	90±7	
Side		
Right	91±7	0.061
Left	85±6	
Type		
Type IV	88±8	0.370
Type V	91±7	

Correlation between the age, sex, side, the Smillie type, and the final score all are nonsignificant (Table 1).

All patients improved regarding pain and function. Severe or constant pain leading to limitation of daily life activities was not reported postoperatively. No cases used especial shoes or brace at the final follow-up. Infection is not reported in this study.

The final score improved in all cases and changed significantly (P<0.001) from 52±14 (range: 29–69)

to 89±7 (80–100). Two patients sustained pain, which is mild and occasional pain, and had limitation of recreational activities without any limitation of daily activities. Three patients felt some sort of instability at the metatarsophalangeal joint without affection of their satisfaction regarding the surgery or their final score.

Discussion

Freiberg's disease is not a common disorder. It usually starts in adolescents with chronic pain and metatarsalgia. The etiology is not adequately understood with traumatic or vascular theories [10]. Conservative treatment was used in early stages to relieve the pain and improve the symptoms such as non-steroidal anti-inflammatory drugs, the use of foot pads or modification of shoes, reduction of weight bearing, and cast immobilization [11].

However, in late stages, operative treatment was usually applied. Options of surgical treatment include cartilage elevation or transplantation, metatarsal osteotomies, interposition arthroplasty, arthroscopic debridement or excision of the distal portion of the proximal phalanx, and head resection.

In this study, debridement and head resection were done in all cases. Compared with procedures for cartilage transplantation, this study was done for end stages of the disease, that is, stage IV and V. Yet, Cartilage transplantation is not used for stage V because failure may occur when repeated load concentration affects the head.

Multiple surgical osteotomies of the metatarsals were advocated to manage Freiberg's disease, like Gautheer's dorsal cuneiform osteotomy below the metatarsal head; it is not advised for type V [12], but in this study, types IV and V were included.

Metatarsal shortening osteotomy is one of the procedures used in treatment of the disease, and it gives pain relief, but weight bearing should be delayed till bone union is achieved [8]. In this study, weight bearing is allowed early after two weeks of the surgical procedure.

Interposition arthroplasty with the tendon of palmaris longus muscle gives good results and allows early weight bearing as in this study, but the possible donor site complications and the acceptance of the patients to take the tendon from the upper limb put some limitation on the use of this technique.

The use of temporary metal interposition device to be removed after 6 months was described. The metal spacer gives preoperative mean scores of 39 and the mean postoperative score of 83.9 according to AOFAS (American Orthopedic Foot and Ankle Society), but the need for a second surgery to extract the spacer is one of the limitations [13].Pastides *et al.* [14] used the technique of debridement and microfracture as a procedure of management of the disease by stimulation of metatarsal head remodeling. They got improvement in pain relief after 6 months, whereas pain relief in this study was noticed very early.

The joint replacement by silastic hinged toe implant was used in late stages of Freiberg's disease, and it improves pain and preserves the joint space and range of motion [15].

Titanium hemiarthroplasty may also be used in cases of affection of the head without affection of the corresponding phalanx [16]. Both total and hemiarthroplasty were used in late stage of Freiberg's disease for pain relief and maintenance of joint motion, but the complications related to arthroplasty such as recurrent pain and synovitis are possible complications compared with this study, which provide pain relief with an easy surgical procedure and with less cost.

Conclusion

Head resection of the affected metatarsal head is an easy and simple method for treatment of the late stages of Freiberg disease with no hardware and no need for secondary procedures. It allows early weight bearing, with minimal cost.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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