Operative versus nonoperative treatment of type 1 fifth metatarsal fracture in nonprofessional athletes

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Introduction
Treatment approach to fifth metatarsal fractures (FMFs) in athletes has been largely influenced by the eagerness to reduce the time away from sport and ensure healing, which provided the drive for primary fixation as the accepted standard of treatment for the athlete.

Patients and methods
The current study was conducted as a prospective cohort study. A total of 24 patients who had FMF type 1 (avulsion of the tuberosity) were divided into two groups. Group 1 included 12 patients who underwent open reduction and internal fixation using a single screw, whereas group 2 included 12 patients who underwent nonoperative treatment in the form of below-knee cast.

Results
The average American Orthopaedic Foot and Ankle Society score for group 1 was 98.3, whereas for group 2 was 93.9 (P=0.03). The average visual analog scale for pain in group 1 was 0.5, whereas in group 2 was 1.1 (P=0.13). The average fracture union time in group 1 was 3.8 weeks, whereas in group 2 was 7.5 weeks (P=0.00001). The average time for return to sports in group 1 was 7.1 weeks, whereas in group 2 was 8.7 weeks (P=0.00023).

Conclusion
Operative treatment of FMF type 1 showed significantly superior American Orthopaedic Foot and Ankle Society scores, less fracture healing time, and less time required to return to recreational sports over those who were treated conservatively; however, there was no difference in pain scores.

Keywords:
athletes, fifth metatarsal fractures, foot fractures, metatarsal fractures, nonoperative, operative

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Introduction

Fifth metatarsal fracture (FMF) is considered one of the most common fractures of the forefoot occurring especially in athletes [1,2]. Incidence is 1.8/1000/year [3,4]. Treatment options particularly for proximal fractures are still controversial. The lax use of the term 'Jones fracture' shares a role in increasing these controversies. Recently, there is an evolving debate on whether athletes should be treated differently from nonatheletes.

Knowledge of the anatomy of the base of the fifth metatarsal is mandatory for surgeons to distinguish FMF types, as healing and treatment differ among different types. A total of three fracture zones could be identified: zone 1–fracture involving the tuberosity, zone 2–metaphyseal–diaphyseal junction (Jones), and zone 3–diaphyseal fractures [5]. Torg [6] classified the radiograph appearance of the proximal FMF into three types: type 1–fracture on the lateral aspect of the tuberosity, extending proximally into the metatarsocuboid joint; type 2–Jones fracture, beginning laterally in the distal part of the tuberosity and extending obliquely and proximally into the medial cortex at the fourth and fifth metatarsal base articulation; and type 3–fracture distal to the fourth and fifth metatarsal base articulation.

Blood supply to the proximal fifth metatarsal occurs through a nutrient artery, metaphyseal arteries, and periosteal arteries. The nutrient artery enters the bone from the medial aspect at the junction of the proximal and middle thirds of the diaphysis and terminates in branches that travel both proximally and distally. The metaphyseal arteries originate from the surrounding soft tissues and penetrate the metaphysis in a random distribution. The nutrient artery while continuing proximally passes across the so-called watershed area at the metaphyseal–diaphyseal junction. This watershed area creates an avascular zone, which can increase the risk of delayed union or nonunion [7–9].

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Recently, treatment approach to FMF in athletes has been largely influenced by the eagerness to reduce the time away from sport and ensure healing. Increase in studies reporting high nonunion rates, refracture rates, and delayed return to activities with nonoperative treatment has provided the drive for primary fixation as the accepted standard of treatment for the elite athlete [10,11].

Several studies recommended the operative treatment for FMF in elite athletes [10–12]. The purpose of the current study was to compare the operative versus nonoperative treatment of type 1 FMF in non-professional athletes.

Patients and methods

The current study was conducted as a prospective cohort study. A total of 24 patients who had FMF type 1 (avulsion of the tuberosity) were divided into two groups. Group 1 included 12 patients who underwent open reduction and internal fixation using a single screw, whereas group 2 included 12 patients who underwent nonoperative treatment in the form of below-knee cast.

Inclusion criteria were as follows: (i) type 1 FMF: fracture on the lateral aspect of the tuberosity, extending proximally into the metatarsocuboid joint; (ii) displacement less than 4 mm and angulation less than 10°; (iii) age between 16 and 45 years; (iv) fit for anesthesia; (v) closed fractures; (vi) acute injury; and (vii) nonprofessional athletes. Exclusion criteria were as follows: (i) types 2 and 3 FMF, (ii) displacement more than 4 mm and angulation more than 10°, (iii) age below 16 years and above 45 years, (iv) open fractures, (v) multiple fractures, (vi) vascular or neurological injuries, and (vii) professional athletes.

Patients

All patients included in the current study were males. In group 1, the average age was 28.7±8.8 years (range: 18–44 years), whereas in group 2, the average age was 29.5±7.9 years (range: 17–42 years). Comparison between the two groups regarding age was statistically insignificant (P=0.4). In group 1, eight fractures occurred during recreational sports whereas four occurred during activities of daily life. In group 2, 10 fractures occurred during recreational sports, whereas two occurred during activities of daily life.

Nonoperative treatment

Nonoperative treatment protocol applied to group 2 was in the form of below-knee cast for 4 weeks with absolute no weight bearing.

Operative treatment

Using general or spinal anesthesia, a lateral 2 cm skin incision is made over the tuberosity of the proximal fifth metatarsal. Adduction of the forefoot facilitates the identification of the tuberosity. Dissection is performed down to the bone. Care should be taken not to injure the two branches of the sural nerve. After identification of the tuberosity, a 2.5 mm drill bit is used to drill a hole directed distally and medially to the medial cortex. A partial threaded 4 mm bicortical cancellous screw along with a washer is inserted obliquely to fix the fracture (Fig. 1). The length of the screw was checked using fluoroscopy, and closure of the incision was performed in layers.

Outcome measures

For both groups, at 6 months, the American Orthopaedic Foot and Ankle Society (AOFAS) midfoot score and the visual analog scale (VAS) for pain were recorded. Furthermore, time of return to sports, radiological union, presence of delayed union, and nonunion relying on radiographs performed at 4, 8, 12, and 24 weeks after treatment and complications were recorded.

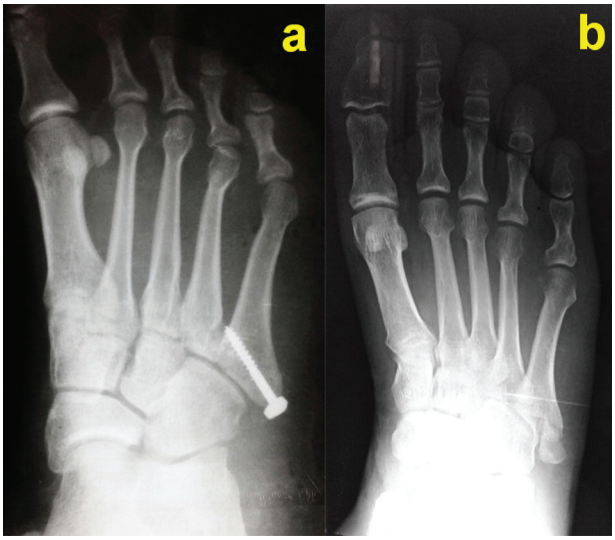
Failure

Failure of treatment and presence of nonunion fracture healing were defined as the presence of tender fracture site and no signs of sound radiological union at 6 months after treatment.

Statistical analysis

Acquired data were analyzed with SPSS (SPSS Inc., Chicago, USA), version 17 software program for

Figure 1



(a) Postoperative radiograph of internal fixation of fifth metatarsal fracture type 1. (b) Preoperative radiograph of fifth metatarsal fracture type 1.

windows. The average (mean) was calculated for the data from the two groups. When comparing the two groups, significance level was set at *P* less than 0.05.

Results

The average AOFAS score for group 1 was 98.3±3.9 (range: 90–100), whereas for group 2 was 93.9±6.6 (range: 85–100). Comparison between the two groups regarding AOFAS revealed statistically significant difference (*P*=0.03) in favor of group 1. The average VAS for pain in group 1 was 0.5±1 (range: 0–2), whereas in group 2 was 1.1±1.4 (range: 0–4). Comparison between the two groups regarding VAS revealed statistically nonsignificant difference (*P*=0.13). The average fracture union time in group 1 was 3.8±0.6 weeks (range: 3–5 weeks), whereas in group 2 was 7.5±1.1 weeks (range: 6–9 weeks). Comparison between the two groups regarding the fracture union time revealed statistically highly significant difference (*P*=0.00001). The average time for return to sports in group 1 was 7.1±0.9 (range: 6–8), whereas in group 2 was 8.7±1 (range: 8–11). Comparison between the two groups regarding time for return to sports revealed statistically highly significant difference (*P*=0.00023) (Table 1).

Complications in both groups were few: in group 1, one patient experienced superficial wound infection, which was successfully treated with antibiotics; whereas in group 2, no complications of the casting occurred.

Discussion

The most noteworthy finding in the current study is that the comparison between conservative treatment and operative treatment of FMF type 1 revealed superior AOFAS scores, shorter fracture healing time, and earlier return to recreational sports for the operative treatment patients over those who were treated conservatively; however, there was no significant difference in pain scores.

Table 1 Shows the comparison between groups 1 and 2 regarding: American Orthopaedic Foot and Ankle Society score, visual analog scale for pain, time of fracture union, and time of return to sports

	Group 1	Group 2	*P*-value
AOFAS			
Average±SD	98.3±3.9	93.9±6.6	0.03
Range	90–100	85–100	
VAS pain			
Average±SD	0.5±1	1.1±1.4	0.13
Range	0–2	0–4	
Union time (weeks)			
Average±SD	3.8±0.6	7.5±1.1	0.00001
Range	3–5	6–9	
Back to sports (weeks)			
Average±SD	7.1±0.9	8.7±1	0.00023
Range	6–8	8–11	

AOFAS, American Orthopaedic Foot and Ankle Society; VAS, visual analog scale.

Several studies support nonoperative treatment for FMF type 1 which heal by either bony union or asymptomatic fibrous union within 6–8 weeks [12,13]. However, others have suggested that operative intervention may be indicated in the event of a significant articular step-off (2–3 mm) or large avulsed fragments involving the articular surface with or without a rotatory component [14].

In their biomechanical study, Husain and Defronzo [15] showed that interfragmentary screw fixation offers better stability than intramedullary construct because of three reasons: (i) interfragmentary screw fixation offers greater fixation stability by the screws purchase in the medial cortex; (ii) bicortical fixation allows the load to disperse over a greater cortex surface area, and so this significantly increases the resistance to load better than does an intramedullary construct; and (iii) bicortical fixation also has significantly more modulus of elasticity than does a intramedullary construct.

Vertullo *et al.* [16] suggested that intramedullary screw fixation of proximal fifth metatarsal fractures offers little resistance to rotation of the proximal and distal fragments relative to one another, and a fixation device that has the capability to resist torsion as well as tension and bending would appear to be optimal to treat these types of fractures.

During the surgical technique used for internal fixation in the current study, it was found that the interfragmentary screw fixation has less chances of injury to the peroneus brevis because the entry point and the direction of screw are more laterally and distally placed.

Limitations of the current study include (i) small number of patients and (ii) short-term follow-up.

Complications were rare as only one patient in the operative treatment group showed superficial infection, which was successfully treated with antibiotics.

Conclusion

Operative treatment of FMF type 1 showed superior AOFAS scores, shorter fracture healing time, and less time required to return to recreational sports over those

who were treated conservatively; however, there was no difference in pain scores.

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Conflicts of interest
There are no conflicts of interest.

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