

# INTRAMEDULLARY SCREW FIXATION OF PROXIMAL FIFTH METATARSAL FRACTURES IN ATHLETES

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## ABSTRACT

**Objective:** The purpose of this study was to review the short- and long-term clinical and radiological results of intramedullary compression screw fixation of proximal fifth metatarsal fractures in athletes. **Methods:** Eleven male and six female active patients with fifth metatarsal zone II and zone III fractures fixed with a 4.5-mm cannulated compression screw were evaluated by chart review, review of radiographs, and clinical evaluation. Fifteen of the patients were high-level athletes (soccer: n=11; basketball: n=1; track and field: n=3) and two were recreational-level athletes. Mean follow-up from surgery to evaluation was 54

(38-70) months. **Results:** Mean time to healing as shown on radiographs and mean time to return to full activity after surgery were 7.3 and 7.5 weeks, respectively. All patients were able to return to their previous levels of activity. There were no reports of union delay, nonunion or refracture to date. **Conclusion:** In our patients, cannulated screw fixation of proximal fifth metatarsal fractures was a reliable procedure with low morbidity associated that provided athletes a quick return to activity. **Level of Evidence I, Case Series.**

**Keywords:** Fracture fixation, internal. Metatarsal bones. Fracture fixation, intramedullary. Athletes.

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## INTRODUCTION

The current medical literature has not reached a consensus with regards to the diagnosis, classification, pathomechanics and therapeutic approach to proximal fifth metatarsal fractures. This controversy dates back to 1902 when Sir Robert Jones published his well-known article "Fracture of the Base of the Fifth Metatarsal Bone by Indirect Violence", motivated by the injury that he himself sustained while dancing,<sup>1</sup> and has been perpetuated by the universal use of the designation "Jones fracture" for all the fractures at the base of the fifth metatarsal. The particularity of this type of fracture is essentially tied to the variations existing in the proximal bone structure of the fifth metatarsal, which is divided into three distinct anatomical zones.<sup>2,3</sup> (Figure 1) This division allows us to distinguish between the avulsion fracture of the tuberosity (zone I), the true Jones fracture (zone II) and the fracture of the proximal metatarsal diaphysis (zone III).

Fractures in zone I frequently result from traction forces exerted at the insertion of the peroneus brevis tendon and/or of the external chords of the plantar fascia. Essentially affecting spongy bone, it is associated with high rates of consolidation, with consensus regarding conservative treatment with weight

bearing as tolerated. Fractures in zone II (most distal region of the tuberosity where the fourth and fifth metatarsals articulate) and zone III (region distal to the zone where the strong ligaments that join the fourth and fifth metatarsals are inserted), in view of less efficacy in the regional blood supply, are associated with longer consolidation times and higher rates of complication.<sup>3-5</sup> Fractures in zone III usually result from cyclic loading that culminates in the mechanical failure of the skeletal structure - stress fracture. They occur in individuals involved in demanding physical or sports activities, characterized by the repetition of the movement that brought about the fatigue, such as members of the armed forces or athletes or basketball players,<sup>5,6</sup> and constitute an additional therapeutic difficulty given the need for speedy recovery in this kind of patient. (Figure 2) These peculiarities inherent to proximal fifth metatarsal fractures may pose a challenge to the orthopedist and can sometimes produce high rates of disability, especially in athletes. The literature contains countless accounts of refracture, delay or even nonunion. Ortiguera reported rates of nonunion that are close to 50%<sup>7</sup> while Kavanaugh *et al.*<sup>8</sup> suggested rates of consolidation delay that could reach 66%.

All the authors declare that there is no potential conflict of interest referring to this article.

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The study by Dameron in 1975 was one of the first to suggest that the proximal fifth metatarsal fracture should have a therapeutic approach according to the patient's level of activity.<sup>9</sup> Other authors subsequently reinforced this assumption, reporting important rates of refracture, delay in consolidation and prolonged recovery times in athletes with fractures treated conservatively.<sup>10</sup> Clapper et al.<sup>11</sup> described a rate of nonunion in 28% of the patients treated for eight weeks with plaster cast immobilization without bearing weight on the affected limb. The average consolidation time in the group treated successfully was 21.2 weeks. It should be noted that prolonged immobilization of the ankle can imply obvious deleterious effects both for the soft tissues and for the skeletal structure of the lower limb, namely the occurrence of diffuse disuse osteoporosis. On the other hand, excellent clinical and functional results have



**Figure 1.** Anatomical division of the fifth metatarsal into three different zones.



**Figure 2.** Fatigue fracture of the fifth metatarsal (zone III) in a soccer player.

been reported in cases of fifth metatarsal fracture referred for open treatment with internal fixation using a screw or a tension band.<sup>12-17</sup> The intramedullary fixation of proximal fifth metatarsal fractures was described for the first time by Kavanaugh et al.<sup>8</sup> The advantage associated with this procedure involves its technical simplicity and its scarcely invasive nature that could be indicated in patients with levels of activity that require a rapid return and without sequelae. The aim of this study was to evaluate the clinical and functional effectiveness of intramedullary cannulated compression screw fixation of fractures in zones II and III of the fifth metatarsal in a population of athletes.

## MATERIAL AND METHODS

A group of 17 athletes (11 men and 6 women) submitted to surgical fixation of proximal fifth metatarsal fracture (zone II, n=8; Zone III, n=9) were studied retrospectively through clinical and imagiological evaluation as well as a review of the clinical process. Seven fractures occurred in the right foot and 10 in the left foot. The patients' average age was 19.9 years (15-28 years). Eleven of the athletes sustained the injury while playing soccer, one while playing basketball, three during athletic pursuits and two while jogging. All the athletes presented recurrent or persistent pain in the fifth metatarsal metaphyseal-diaphyseal junction, rendering them unfit to practice their habitual sport.

## SURGICAL TECHNIQUE

All the patients were operated under general anesthesia in dorsal decubitus, tilted 45° towards the unaffected side in order to expose the lateral edge of the foot, without tourniquet use. The metatarsal base was approached through a small dorsolateral incision followed by rhomboid dissection taking care not to harm the cutaneous branches of the sural nerve. The interval between the short and long fibular tendons was used to arrive at the bone plane. A Kirschner wire was introduced in the proximal tuberosity under anteroposterior (AP) and lateral radiographic and fluoroscopic control, passing through the spinal canal and by the fracture line. A cannulated compression screw in a diameter of 4.5mm was introduced as soon as satisfactory positioning was achieved in the AP and lateral image. The final objective was rigid fracture fixation with compression of the tops. The screw head was introduced into the cortex in order to avoid interference in the midfoot. (Figure 3) No type of bone graft was used. Once closed, the wound was infiltrated with a solution of ropivacaine hydrochloride (7.5mg/ml). The post-operative protocol recommended immediate progressive total weight bearing with functional orthosis and external support. Sports activity with running and jumping was partially limited



**Figure 3.** Intraoperative images showing the introduction of the screw head in the cortex in order to avoid interference in the midfoot.

until six weeks after surgery. The average follow-up time from surgery to the date of our evaluation was 54 months (38-70). We gathered the information from the clinical process relating to age, sex, previous levels of activity, date of surgery, recuperation period (time to return to unrestricted activity), time to radiographic consolidation and complications (infection, refracture, nonunion and re-interventions). The clinical evaluation included the radiographic study and the application of a functional evaluation questionnaire based on the scale of the American Orthopedic Foot and Ankle Society (AOFAS) for the midfoot. The AOFAS scale is a 100-point scale that records pain (40 points), function (45 points) and alignment (15 points).

## RESULTS

We verified a clinical cure rate in 100% of the fractures. The average time to return to unrestricted sports activities was 7.5 weeks (2 - 12). Fourteen of the athletes returned to competitive activity in nine weeks or less. We verified a mean score of 95 points on the AOFAS scale for the midfoot. In the pain subscale the mean score observed was 37 out of 40 possible points. All the patients obtained the maximum score with regards function and they all reached the levels of sports activity prior to injury. The average time to discovery of signs of radiographic consolidation was around 7.3 weeks. The consolidation rate on the date of evaluation was 100%, as determined by an independent musculoskeletal radiologist. (Figure 4). There were no reports of refractures or other complications, and none of the patients was submitted to screw extraction, up to the date of this study. The results are summarized in Table 1.

## DISCUSSION

Fractures in zones II and III of the fifth metatarsal can prove a therapeutic challenge and evolve with important disability in some patients. The traditional therapeutic approaches include plaster cast immobilization, functional orthoses and fixation with solid com-



**Figure 4.** Healed fracture in the radiographic control executed 6.2 weeks after surgery.

pression screws. As demonstrated in the study by Dameron<sup>3</sup>, the rate of nonunion in fifth metatarsal fractures treated conservatively in athletes can be as high as 25%. Once operated on the fractures will have consolidated in eight to 10 weeks without any reports of complications. Kavanaugh *et al.*<sup>8</sup>, besides noting a consolidation delay rate above 60%, also reported 11 refractures in 18 athletes treated conservatively. They also demonstrated a consolidation rate of 100% and no refractures in 13 patients treated with intramedullary screw fixation. However, there are reports of clinical failure

**Table 1.** Details of Athletes with Proximal Fifth Metatarsal Fracture Treated with Intramedullary Compression Screw.

Athlete	Sex	Age, years	Zone	Level Previous Activity, Tegner scale	Return to Activity, weeks	% Consolidation	Pain Subscale	Function Subscale	Complications	Level of Activity after Surgery, Tegner scale
1	F	19	II	8	8	100	36	45	-	8
2	M	21	III	10	6	100	38	45	-	10
3	M	15	III	9	8	100	40	45	-	9
4	M	17	II	10	8	100	38	45	-	10
5	F	23	II	8	7	100	36	45	-	8
6	F	28	III	6	6	100	39	45	-	6
7	M	20	III	9	10	100	36	45	-	9
8	M	21	III	9	8	100	33	45	-	9
9	M	19	II	8	2	100	39	45	-	8
10	M	18	III	9	5	100	38	45	-	9
11	F	21	II	9	6	100	40	45	-	9
12	M	19	II	10	10	100	36	45	-	10
13	M	18	III	9	11	100	35	45	-	9
14	F	20	II	9	8	100	38	45	-	9
15	M	19	III	10	10	100	36	45	-	10
16	M	17	III	9	8	100	38	45	-	9
17	M	21	III	9	6	100	38	45	-	9
18	F	22	II	9	4	100	40	45	-	9
19	M	20	III	9	12	100	33	45	-	9
Mean		19.9			7.5	100	37	45		

and the use of cannulated screws, although described by some authors, has not been reported as universally consensual in the current orthopedic literature. Glasgow *et al.*<sup>18</sup> warned against their use after have verified their clinical and radiographic failure in a single athlete treated by this method. In this study, the authors give an account of their experience over a period of more than five years, without having detected complications. The significant shortening of the recovery time and of the time taken to return to either sports activity or work activity, paired with the reliability associated with this procedure, are the two main reasons that led us to defend the surgical treatment of this type of fracture in a selected group of patients. The use of cannulated screws facilitates the surgical technique when compared with conventional compression screws, allowing greater precision thanks to the help of the guide wire. Our results allowed us to demonstrate a consolidation rate of 100% and the return to previous levels of activity, without associated symptomatology. The criterion used to allow the return to activity was based on the absence of pain upon clinical examination and during the performance of functional activities such as running, even without radiographic evidence of effective consolidation. The

average times of return to activity are consistent with previous studies.<sup>12,13,17</sup> The nonuse of forms of rigid immobilization in the postoperative period and immediate rehabilitation did not show adverse effects, and the authors are convinced of their benefits in allowing early recovery of the range of motion and the improvement of the blood supply and of the osteoblast activity through the action of the load on the lower limb.

## CONCLUSION

The intramedullary fixation of fifth metatarsal zone II and III fractures with cannulated compression screw demonstrated excellent functional results and early and complete recovery. When compared with the various therapeutic options available for the treatment of these fractures, the technique and the postoperative protocol described provided the patients with a simple and scarcely invasive option with a rate of complications that appears nonexistent to date.

The authors believe that the surgical fixation of fifth metatarsal fractures with cannulated compression screw is an effective, reliable procedure that is indicated in a selected group of patients.

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