

Evaluation of Internal Fixation of Base of Fifth Metatarsal Fracture of the Foot by Screw

Abdelsalam Eid Abdelsalam, Abdlkader Fadh Almahdi Mautog*, Fahmy Samir Fahmy Gerges, Salah Mahmoud Abdelkader

Department of Orthopedic Surgery, Faculty of Medicine, Zagazig University, Egypt

*Corresponding author: Abdlkader Fadh Almahdi Mautog, E-Mail: adbegtelawe1988@gmail.com

ABSTRACT

Background: Although successful treatment of 5th metatarsal Jones fractures with intramedullary screw fixation is common, nonunion and refracture rates are not insignificant.

Objective: This study aimed to monitor the management results of internal fixation of the base of the fifth metatarsal fracture of the foot by the intramedullary screw.

Patients and Methods: At Zagazig University Hospitals, we performed a prospective study on 18 patients who had "Jones fractures" in zone II at the base of their fifth metatarsal bone and who had all been treated with intramedullary screw fixation.

Results: All the fractured patients had close isolated fractures 83.3% of them operated within the first 48 hours, only three patients needed more than 48 hours to be operated. The operation time in most of patients (77.8%) was less than one hour with mean 63.3 minutes. Most of patients (72.2%) achieved excellent, while the rest had good outcome according to AOFAS score at final follow up.

Conclusion: It is safe and effective to use early screw fixation in the treatment of acute Jones fractures, which leads to a faster clinical union and a return to normal daily activities.

Keywords: Fifth metatarsal fracture, Internal fixation.

INTRODUCTION

A crucial diagnostic problem arises when dealing with fractures of the fifth metatarsal. Prognosis and treatment can be drastically altered by only millimeters of variation in site. Re-injury and chronic incapacity can be caused by a treatment plan that isn't up to standard. The difficulty of making an accurate diagnosis and treating a fracture is exacerbated by the use of confusing fracture nomenclature [1]. Surgeons frequently use surgical fixation for Jones fractures of the metaphyseal-diaphyseal watershed junction in athletes. It is still the most often used method of fixation, with intramedullary screws [2].

As many as 70% of metatarsal fractures occur in the fifth metatarsal, and 80% of these fractures occur in the proximal portion of the bone. Women with poor bone mineral density are more likely to suffer from these fractures than women in their third or seventh decade. An athlete's fifth metatarsal bone is frequently fractured by stress [3]. Traumatic or recurrent forefoot damage can cause an injury to the fifth metatarsal. It is common for avulsion fractures to occur in Zone 1. These fractures are caused by an abrupt episode of supination of the forefoot with plantar flexion. The plantar fascia's lateral band and the peroneus brevis are pulled as a result [4].

Three conventional radiographic views of the foot are utilized when imaging for a suspected metatarsal fracture: lateral, anteroposterior, and a 45-degree oblique. Standard three-views of the foot do not detect acute stress fractures in the majority of cases. It is recommended that 10 to 14 days following the onset of symptoms, radiographs are taken. As soon as a radiolucent reabsorption gap appears surrounding the fracture, the diagnosis is deemed certain. A CT scan is recommended

to rule out a Lisfranc fracture dislocation in cases of more severe midfoot trauma [5].

The treatment of a 5th metatarsal fracture is determined by the fracture type, the extent of the patient's previous ailments, and their personal characteristics. Treatment options include non-operative and surgical approaches that take into account a variety of factors, including the amount of activity of the patient. If the displacement or ten-degree plantar angulation of a neck or shaft fracture is greater than 3 to 4 mm and a closed reduction is not enough, operational intervention is recommended [6].

The surgical treatment of proximal fifth metatarsal fractures includes a number of options, such as, internal fixation with minifragment plate and screws, closed reduction and cross-pinning with Kirschner-wire (K-wire) fixation, corticocancellous bone graft, open reduction and percutaneous fixation with an intramedullary screw. Although successful treatment of 5th metatarsal Jones fractures with intramedullary screw fixation is common, nonunion and refracture rates are not insignificant [7].

The purpose of this study was to monitor the outcomes of intramedullary screw repair of the foot's fifth metatarsal fracture base.

PATIENTS AND METHODS

This study was conducted in the Orthopedic Surgery Department, Zagazig University Hospitals. 18 patients complaining of fracture base of fifth metatarsal bone "Jones fracture" were included in this study. All the included patients were treated surgically through percutaneous screw fixation.

Inclusion criteria: Age from 18 – 50 years, gender: male and female, fracture type: Jones fracture type II of the base of 5th metatarsal, closed fracture, and acute fracture.

Exclusion criteria: Infection, open fractures, pathological fracture, and skeletal immaturity.

Ethical consent:

Zagazig University's Research Ethics Council approved the study and every participant signed informed consent and submitted it to ZU-IRB#7036. We adhered to the Helsinki Declaration, which is the ethical norm for human testing established by the World Medical Association.

All patients were subjected to the following:

Patients history: The patient's name, sex, age, address, and smoking habits were gathered as part of the patient's clinical history. If or not there are any additional injuries as a result of the incidence.

Clinical evaluation:

Examination: Range of motion, tenderness, skin condition, neurovascular examination, and swelling as well as examination for associated injuries were performed.

Evaluation by x-ray: Antero-posterior (AP), oblique, and lateral views of the foot were included in this section. Prior to surgery, a patient's fractures were classified and a surgical plan was devised using preoperative imaging.

Laboratory evaluation: Liver function tests (ALT, AST and albumin). Complete blood picture (CBC). Serum creatinine. Virology tests: HBV-Ag, HCV-Ab and HIV-Ab, and random serum glucose (RSG).

Operative technique:

Implants: Using an image intensifier, a 4.00-mm cannulated screw with a washer was implanted percutaneously along the fracture line.

Surgical technique:

Anesthesia: Spinal anaesthesia was used to sedate each and every one of them.

Position:

In supine position with image intensifier guidance, patients were operated on using a typical radiolucent orthopedic table. Image intensifiers were put on top of the patient's supine body, with their affected foot resting on top. Anteroposterior, lateral, and oblique views of the foot were easily obtained thanks to this configuration, and the fifth metatarsal bone's base was easily accessible. There was no tourniquet used (Figure 1).

Guide wire insertion:

The fifth metatarsal bone was stabbed around 0.5 to 1 cm proximal to the wound. Before inserting the guide wire, an incision was made in the peroneus brevis tendon and the plantar fascia, which was guided by an ultrasound imaging. AP, LAT, and oblique pictures are taken after the guide wire has been introduced to ensure it is in the intra medullary canal of the fifth metatarsal bone (figure 2).



Figure (1): Patient positioning.



Figure (2): Guide wire insertion.

Insertion of cannulated drill: The intramedullary fracture was punctured with a cannulated drill.

Insertion of cannulated screw: A partly threaded, 4.0 mm, cannulated screw was then put over the guide wire to assure intramedullary insertion of the screw.



Figure (3): AP, oblique and lateral views intra-operative showing introduction of guide wire and cannulated screw. Regardless of the overall length of the screw, each 4.0 mm screw has 16 mm threads. After the intramedullary screw had been documented, the guide pin was withdrawn. The intramedullary location was ensured, and all threads were positioned distally from the fracture site. A single stitch is used to close the wound. Post-operative discomfort, function, footwear requirements, walking distance, gait irregularity, and alignment were all monitored in all patients. During the first 24 hours following surgery, the patients were given prophylactic parenteral antibiotics as a precautionary measure. Results were evaluated using the AOFAS score midfoot scale.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test (χ^2) to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed as mean \pm SD (Standard deviation). Independent samples t-test was used to compare between two independent groups of normally distributed variables (parametric data). P value < 0.05 was considered significant.

RESULTS

The mean patient’s age was 31.8 ± 9.2 years ranged from 18 to 50 years. Male represented 61.1%, and females represented 38.9%. The right side represented 83.3% of the fractures. Half of the patients were injured due to twisted injuries as it represented the most common mechanism of injury, followed by MVA (27.8%) and direct trauma (22.2%), most patients included in this study were males (61.1%). While females represented 38.9% (**Table 1**).

Regarding operative time among the studied group, more than three quarters of operations needed less than 1hour, while the rest needed more (**Table 2**).

About 44.4% of fractures united within 6 weeks, while only 22.2% needed more than 8 weeks for full radiological union achievement (**Table 3**).

Most of our patients were excellent (72.2%) and the rest were good. The mean AOFAS score was 87.2 ± 4.6 , ranged from 78 to 91 points. At the end of follow-up 14 patients (77.8%) scored 40 points “they had no pain”, while 4 patients (22.2%) scored 30 points “mild pain”. While, all the patients had no limitations and needed no support “all patients achieved the full ten points”. Footwear requirements at the end of follow up achieved 5 points according to AOFAS score. Also, all patients could walk more than 600 meters as maximum walking distance and so score 10 points. Concerning walking surface, gait abnormality and alignment, all the patients

achieved the full score (**Table 4**). All patients had no complications (100 %) (**Figure 4**)

Comparison between patients with different functional outcome regarding patient characteristics among the studied group, only age and union time had statistical significant effect on the functional outcome according to AOFAS score at the end of follow-up (**Table 5**).

Table (1): Demographics among the studied group

Variable	The studied group (N=18) mean \pm SD	
Mean age (years): (Range)	31.8\pm9.2 (18-50)	
Variable	NO	%
Age grouping		
18-29 Years	8	44.4%
30-39 Years	6	33.4%
40-50 Years	4	22.2%
Gender		
Male	11	61.1%
Female	7	38.9%

Table (2): Operative time among the studied group

Variable	NO (N=18)	%
Operative time		
Less than one hour	14	77.8%
More than one hour	4	22.2%

Table (3): Union time among the studied group

Variables	NO (N=18)	%
Union time		
5-6 Weeks	8	44.4%
7-8 Weeks	6	33.4%
>8 Weeks	4	22.2%

Table (4): AOFAS score among the studied group

Variable	NO (N=18)	%
Final AOFAS Score		
Excellent	13	72.2%
Good	5	27.8%

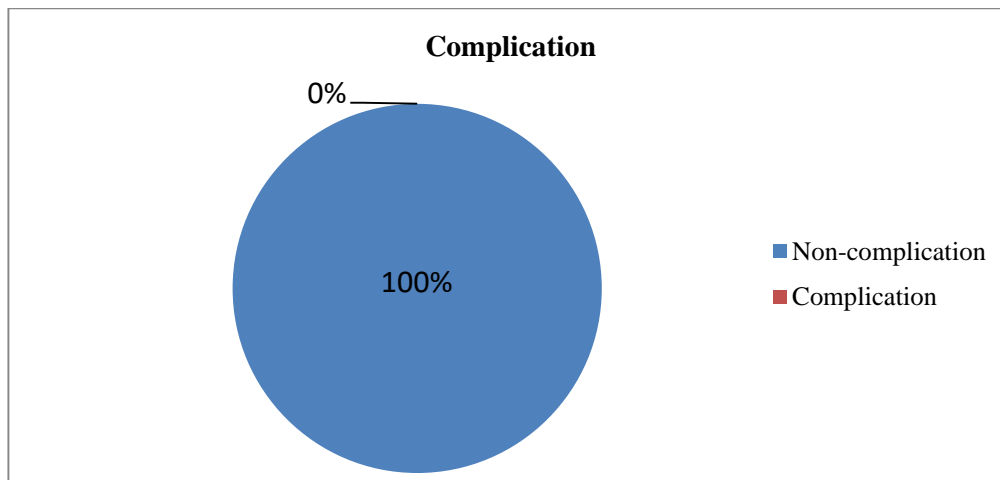


Figure (4): Represented complications among the studied group.

Table (5): Comparison between patients with different functional outcome regarding patient characteristics among the studied group

Variable	Excellent		Good		χ^2	P
	NO. (13)	%	NO. (5)	%		
Age group						
18-29 Years	8	61.5%	0	0.0%	7.6	0.02*
30-39 Years	4	30.8%	2	40%		
40-50 Years	1	7.7%	3	60%		
Gender						
Male	9	69.2%	2	40%	1.2	0.3
Female	4	30.8%	3	60%		
Side affected						
Right	10	76.9%	5	100%	1.4	0.2
Left	3	23.1%	0	0.0%		
Smoking						
Smoker	4	30.8%	2	40%	0.1	0.7
Non- Smoker	9	69.2%	3	60%		
Mechanism of injury						
Twisted injury	7	53.8%	2	40%	1.3	0.5
MVA	4	30.8%	1	20%		
Direct trauma	2	15.4%	2	40%		
Time before surgery						
< 48 hours	12	92.3%	3	60%	2.7	0.09
> 48 hours	1	7.7%	2	40%		
Union time						
5 to 6 weeks	8	61.5%	0	0%	7.6	0.03*
7 to 8 weeks	4	30.8%	2	40%		
> 8 weeks	1	7.7%	3	60%		
Operative time						
Less than 1 hour	10	72.2%	4	80%	0.02	0.9
More than 1 hour	3	27.8%	1	20%		
Follow-up						
< Than 6 months	8	61.5%	3	60%	0.2	0.6
> Than 6 months	5	38.5%	2	40%		

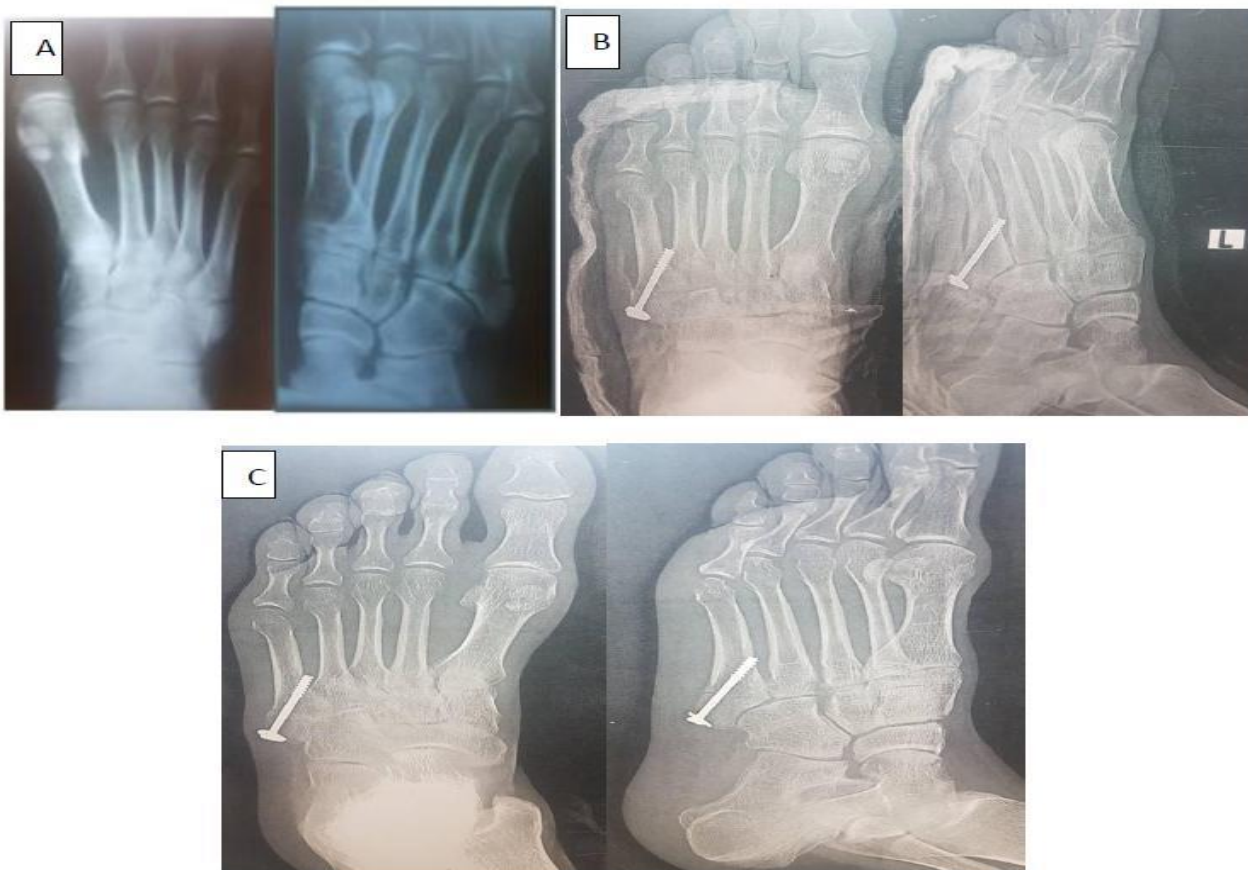


Figure (5): 34 years old male patient with fracture Lt fifth metatarsal in zone II. The mode of trauma was twisting injury after fall into the ground. He was operated on second day. A) AP and Oblique views showing fracture of fifth metatarsal in zone II, B) AP and Oblique views of patient immediate post-operative, C) AP and oblique views after 3 months showing complete union radiologically.

DISCUSSION

Treatment is difficult for fractures of the proximal fifth metatarsal at the diaphysis-metaphysis junction. First described by Sir Robert Jones in 1902 when he documented four cases, including his own^(4,8).

Doctors face a significant diagnostic hurdle when dealing with proximal metatarsal fractures. A millimeter's variation in placement can have a profound effect on the prognosis and treatment strategy; a substandard treatment regimen can lead to a delayed union, reinjury, and chronic impairment. The difficulty of making an accurate diagnosis and treating a fracture is exacerbated by the use of confusing fracture nomenclature⁽⁴⁾. With or without grafting, intramedullary screw fixation is commonly used to treat fractures of the fifth metatarsal bone. In order to achieve a tight fit of the screw to the endosteum, it is recommended that the medullary canal be reamed before insertion of the screw. An incompletely-threaded screw is used to generate fracture compression, and all the threads must pass through the fracture line. If you're going to place a larger screw, you're going to run the danger of diaphyseal fracture. When there is significant intramedullary sclerosis, some surgeons will employ autografts at the fracture site⁽⁹⁾.

The mean patient's age was 31.8 ± 9.2 years ranged from 18 to 50 years. More than three quarters of

them were young adults (below age of 40 years). Male represented the far most commonly affected gender as they represented 61.1%, while 38.9% of patients were females. The right side was the far most affected side as 15 out of 18 patients had been injured on their right foot. Smokers represented only one third of the patients. This demographic data are comparable with **Bucknam et al.**⁽¹⁰⁾, who documented that the mean age was 33.4 ± 14.2 years, 75% of the patients were males, 19% of the patients were smokers, the patients on their study had mean time before surgery 13.3 day ranged from 1 to 31 days. Also, **Bowes and Buckley**⁽¹¹⁾ documented that the mean age was 33.75 years, 14 out of 20 patients were below 38 years, while only 6 patients were above this age. Also they reported that 50% of the patients were males and 70% of the patients had the fractures at the right side.

Regarding the union time, all our patients had full union at the end of follow-up, the union was assessed clinically by absence of pain and tenderness over the fractured site, as well as radiologically by the disappearance of a fracture line and the appearance of bridging trabeculae on three of four cortices. The mean time for full union was 6.9 weeks, ranged from 5 to 10 weeks, most of patients 77.8% needed about two months (8 weeks) for full union, only 22.2% of patients needed time between 8 to 10 weeks for full union. This is comparable with **Bucknam et al.**⁽¹⁰⁾, who documented

that the mean union time was 10.8 weeks ranged from 5.6 to 17.1 weeks. Also, **Adhikari et al.** ⁽¹²⁾ reported that the mean duration of the clinical union for the screw group was 8.27 weeks ranged from 7-10 weeks.

Regarding the AOFAS score, the mean AOFAS score was 87.2 points. None of our patients had poor outcome, most of them achieved more than 80 points “i.e. excellent “(72.2%), while the rest achieved 60 to 79 points” i.e. good AOFAS” according to AOFAS score at final follow up.

Statistically the age of the patients along with union time were the only variables affected functional outcomes, as the age ranged from 18 to 50 years, with mean age 31.8 years, most of the patients (44.4%) were younger than 30 years, while only 4 patients (22.2%) were older than 40 years. All the patients below 30 years had excellent outcome, two thirds of the patients aged between 30 to 39 years had excellent outcome, while only 25% of patients aged above 40 years had excellent outcome (P = 0.02. This was comparable with **Bowes and Buckley** ⁽¹¹⁾ who documented that the mean AOFAS score was 87 ranged from 80 to 90 and they had age distribution nearly similar to the age distribution in this study. Also, **Porter** ⁽¹³⁾ reported that no statistical differences in the fifth metatarsal jones fracture fixed by 4.5- and 5.5-mm cannulated stainless-steel screws, as the mean foot & ankle pain score for 5.5 cannulated screw was 96.5, while for the 4.5 group was 95.8.

Regarding the complications, our study revealed no complications in any of our patients, this could be due its small incision, which lower the incidence of infection. Also, they had compressive effect, which facilitated the union rate. **Bowes and Buckley** ⁽¹¹⁾ documented no complications, while **Bucknam et al.** ⁽¹⁰⁾ reported that the incidence of complications was 12.5% mostly was implant pain requiring implant removal in 9.3%, while the SSI was in 3.2% of patients. The results also agree with **Devries et al.** ⁽¹⁴⁾ who treated jones fracture with intramedullary screw either titanium or stainless steel and found that the complications were rare in both groups, mostly nonunion, which occurred only in 6% of all the patients.

CONCLUSION

Early screw fixation was a safe and effective method of treatment for acute Jones fracture and resulted in earlier clinical union and allowed patients to return to normal daily activities with excellent to good functional outcome.

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