

# The Clinical Outcomes of Operative Treatment versus Conservative Treatment for 5th Metatarsal Diaphyseal Fractures

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## Abstract

**Background:** Fifth metatarsal fractures are one of the most common foot fractures. The incidence of fifth metatarsal fractures is reported at 6.7 fractures for every 10,000 people. The fracture of the proximal fifth metatarsal is not only owing to the direct injuries in this area, but also to the indirect injuries with plantar flexion. These fractures can lead to a serious incidence rate, especially in athletes. During the time of competition, the time is obviously shortened, and refracture, sometimes it cannot resume sports.

**Aim and objectives:** To assess and evaluate the efficacy of conservative and surgical approaches to treating 5th metatarsal diaphyseal fractures.

**Patients and methods:** At Al-Azhar University's Orthopedic Surgery Department, Faculty of Medicine, a randomized prospective comparative study was carried out. We enlisted the help of patients from Dessoq General Hospital, El-Hussein and Sayed Galal Hospitals, and their Outpatient Clinics and Emergency Units. It was performed at a period started from March 2023 till September 2024.

**Results:** In terms of ankle range of motion (ROM), partial weight bearing, complete weight bearing, and time to bone union, the conservative group significantly outperformed the surgical group. In terms of delayed union and malunion, the conservative group had a statistically significantly higher rate than the surgical group. The surgical group had a statistically significant rise in the foot and ankle disability score compared to the conservative group.

**Conclusion:** Surgical treatment generally offers superior outcomes in terms of faster recovery, reduced complications, and overall lower disability. These findings suggest that surgical intervention is often preferable for achieving quicker and more reliable recovery, although treatment decisions should be individualized based on patient-specific factors and desired outcomes.

**Keywords:** Operative treatment; Clinical outcomes; Conservative treatment; Metatarsal diaphyseal fractures

## 1. Introduction

The fracture of the proximal fifth metatarsal is not only owing to the direct injuries in this area, but also to the indirect injuries with plantar flexion. These fractures can lead to a serious incidence rate, especially in athletes. During the time of competition, the time is obviously shortened, and refracture, sometimes it cannot resume sports.<sup>1</sup>

There is no unified classification system; however, the Lawrence and Botte classification is recommended.<sup>2</sup> The fifth metatarsal bone is divided into 3 anatomical zones where fractures can occur. Zone 1 is the tuberosity; zone 2 is the metaphyseal-diaphyseal junction, which

extends into the fourth-fifth intermetatarsal facet and is also known as the Jones fracture; and zone 3 consists of the proximal diaphyseal fractures, which are located within 1.5 cm of the tuberosity.

Another type of fracture is the so-called Dancer's fracture, a long spiral and angulated fracture that extends into the distal metaphyseal area.<sup>3</sup>

Dancer's fractures are diagnosed in 11% to 25% of fifth metatarsal fractures and 5% of metatarsal fractures overall. The optimal treatment for this fracture type is still under debate, and most of the available related literature consists of small retrospective studies or case series.<sup>4</sup>

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Studies have shown different outcomes of treatments. Some have used conservative therapy with or without weight-bearing immobilization for 6 to 8 weeks and achieved excellent results.<sup>5</sup>

Others have used surgical therapy with plates and screws, which resulted in excellent outcomes that were comparable to those of the same therapy for shaft fractures of other metatarsal bones.<sup>6</sup>

Intramedullary screw fixation is currently the preferred operative treatment for proximal metaphyseal-diaphyseal fifth metatarsal fractures, relying upon distal diaphyseal purchase to gain axial compression for stability. While this technique improves union rates, time to healing, and return to play compared to nonoperative management, nonunion and refracture persist in 4% to 30% of patients despite the use of an optimal operative technique.<sup>7</sup>

Furthermore, screw fixation lacks torsional control, and fixation is oriented obliquely relative to the physiologic tensile forces encountered by the fifth metatarsal. As a result, there is potential for motion within the proximal segment. This may predispose patients to delayed union, nonunion, or refracture, particularly in the elite-level athlete in whom these stresses are magnified and more frequent.<sup>7</sup>

The purpose of this research is to evaluate the efficacy of surgical versus non-surgical approaches to treating 5th metatarsal diaphyseal fractures.

## 2. Patients and methods

At Al-Azhar University's Orthopedic Surgery Department, Faculty of Medicine, a randomized prospective comparative study was carried out. We enlisted the help of patients from Dessoq General Hospital, El-Hussein and Sayed Galal Hospitals, and their outpatient clinics and emergency rooms. It was performed at a period started from March 2023 till May 2024 the last case to be operated and last case to be followed up was in September 2024. This study was conducted in adult patients who suffer from the 5th metatarsal diaphyseal fractures.

### Sample size calculation:

The patients referred to our department for treatment of 5th metatarsal diaphyseal fractures were collected according to the calculated formula by Rosner (2011):

$$n = \left[ \frac{Z_{\alpha/2}}{E} \right]^2 * P(1 - P)$$

Where:

n = sample size,  $Z_{\alpha/2} = 1.93$  The key value that separates the middle 95% of the Z distribution from the 5% in the tail, E represents

the margin of error (width of the confidence interval) at 0.0314, and P denotes the prevalence of the outcome variable at 2.4%. Given the limited incidence of 5th metatarsal diaphyseal fractures presenting to hospitals, the calculated sample size comprised 30 consecutive patients following the application of exclusion criteria.

### Method of randomization:

Patients were randomized into two groups of fifteen each using a sequentially sealed opaque envelope method, ensuring that every patient meeting the inclusion criteria had an equal opportunity to participate in the study. Randomization was conducted using a computer-based program guided by a table of random numbers from [www.randomization.com](http://www.randomization.com).

### Inclusion criteria:

Adult patients aged over 18 and less than 45 years, patients aged 45 45-years may suffer from delayed bone union rates, both sexes included, and patients with isolated 5th metatarsal diaphyseal fractures.

### Exclusion criteria:

Individuals outside the specified age range, those with multiple concurrent ipsilateral foot or ankle fractures, patients with open fractures, individuals with significant pre-existing mobility impairments, patients exhibiting gross anatomical anomalies of the foot, individuals with autoimmune diseases (such as diabetes mellitus, Behçet's disease, systemic lupus erythematosus, or chronic rheumatoid arthritis), peripheral vascular disease and pathological fracture, and patients who declined to participate or were uncooperative.

### Method:

All patients were subjected to: personal history: age, sex, education, occupation and telephone number; complaint and its duration; present history: present manifestation, any complications and time from trauma to treatment; past history: cause and time of the trauma, medications used and any other modes of treatment; especial habits such as drugs or smoking.

General Examination was done: to eliminate systemic disorders, vital signs (blood pressure, temperature, heart rate, respiration rate), and indicators of (pallor, cyanosis, jaundice, and lymphadenopathy).

Visual Examination: the affected foot was observed for any visible deformities, swelling, bruising, or abnormal positioning of the toes and foot. Skin Integrity: any signs of open wounds, abrasions, or other skin changes that might indicate an underlying injury or infection were checked. Comparison: the affected foot was compared with the contralateral (unaffected) foot to assess asymmetries.

### Movement:

Range of Motion(ROM): the active and passive range of motion of the toes, foot, and ankle were evaluated. any limitations or pain during movement were noted. Functionality: the patient's ability to bear weight and walk was assessed. any difficulties or pain experienced during these activities were documented.

Routine laboratory investigations such: complete blood count(CBC), prothrombin time(PT) partial thromboplastin time(PTT), INR, and liver functions test(ALT, AST) and kidney functions test(creatinine) were also done.

Procedures:

The surgical group:

Before being placed on the radiologic operating table in a supine or lateral position, each patient underwent either localized spinal anesthesia or a conventional general anesthesia regimen. An approximately 1cm longitudinal skin incision was made at the base of the fifth metatarsal bone to insert the screw during this procedure, which was aided by a tourniquet. The fracture reduction forceps were used to conduct the procedure. An cannulated intramedullary screw size 4.0 mm partial thread was used for the fixation. Additionally, anticoagulation treatment for prevention.

The conservative group:

The plaster slab was extended below the knee to immobilize the patients in the neutral position. After two weeks of using the short leg plaster, the patient was then given two to four weeks of tubular plaster to wear before they could bear weight. To prevent venous thrombosis and muscular atrophy in the lower extremities, it is recommended that the hip and knee joints engage in moderate exercise when immobilized. The risk of venous thrombosis and muscular atrophy in the lower extremities during immobility was mitigated by encouraging moderate hip and knee movements. Additionally, anticoagulant treatment for prevention.

Primary outcome:

Compared to the conservative group, the primary surgical group had a lower incidence of delayed union and nonunion.

Secondary outcomes:

The proportion of patients who required surgery following conservative treatment, the frequency of complications (infection and hardware failure), and the proportion of individuals whose first conservative treatment failed are causes of first-line conservative therapy failure and patient characteristics.

Functional outcomes:

Secondary outcomes were patient-reported complaints and effects on daily living. The results were calculated by analyzing the questionnaires that patients filled out.

Follow-up:

Radiographs were obtained during the outpatient follow-up at 1,3,6, and 12 weeks. Radiographs were taken to check for fracture healing or implant failure. Results were evaluated in terms of functionality, patient satisfaction, range of motion, visual analog scale (VAS)7, and complications. As an outcome measure for ankle and hindfoot disorders, the American Orthopedic Foot and Ankle score (AOFAS) needs scoring from both the patient and the clinician.

Patients with complicated ankle or hindfoot injuries often have their treatment outcomes measured with the AOFAS Ankle-Hindfoot Scale. Both the patient and the doctor are required to fill out the form.<sup>8</sup> This region-specific self-report of function is known as the Foot and Ankle Disability Index (FADI), and it was initially described in 1999.

Ethical considerations:

All necessary committees and boards at Al-Azhar University's Faculty of Medicine gave their stamp of approval before the study could begin, including the Local Research Committee, the Studies Committee, the Research Ethics Committee, and the International Research Board or IRB. Every patient had to sign an informed consent form.

Statistical Analysis:

Statistically sound software. At  $\alpha=0.05$ ,  $p<0.05$ (two-sided) was considered statistically significant in this investigation. The D'Agostino-Pearson omnibus normality test examined interval data distributions. Non-parametric studies were employed since normal distributions were absent. For two-group comparisons, the Mann-Whitney, unpaired t-test was employed, and the Kruskal-Wallis test followed by Dunn's post hoc test was utilized. Trend analysis used Cuzick's rank test. Results were presented as means and SD.

Data distribution normality was tested with the Shapiro-Wilk test. Mean, SD, SE, median, and range for numbers. Non-numerical data frequency and proportion. Student T-Test determined the statistical significance of the parametric variable difference between the study group means. The statistical significance of a non-parametric variable difference between two study groups was assessed using Mann Whitney-Test (U-test). The Kruskal-Wallis Test determined the statistical significance of a non-parametric variable difference between more than two research groups. A Chi-Square test examined the association between two qualitative variables. The level of link between two quantitative variables is assessed via correlation analysis. ROC Curves are useful for assessing the sensitivity and specificity of quantitative diagnostic measures that divide cases into two groups. AUC maximization determined the best cut-off point. An AUC of 0.9 or more implies high accuracy, 0.7–0.9 moderate accuracy, 0.5–0.7 low accuracy, and 0.5 a chance result.

All statistical tests used a 5% significance threshold. A P-value of  $>0.05$  implies non-significant results, whereas a P-value of  $<0.05$  indicates significant results. Results were more significant with lower P-values.

### 3. Results

*Table 1. Demographic data of the studied groups.*

	SURGICAL GROUP N=15		CONSERVATIVE GROUP N=15		TEST OF SIGNIFICANCE	P-VALUE
	mean	±SD	mean	±SD		
AGE(YEAR)	31.6	9.7	30.9	8.6	T=0.209	0.835
	N	%	N	%		
SEX						
MALE	9	60.00%	7	46.70%		
FEMALE	6	40.00%	8	53.30%	X2=0.536	0.434
SMOKING	5	33.30%	4	26.70%	X2=0.159	0.690
SIDE OF THE FRACTURE						
LEFT	6	40.00%	8	53.30%		
RIGHT	9	60.00%	7	46.70%	X2=0.536	0.464
MECHANISM OF INJURY						
TRAUMA	3	20.00%	6	40.00%		
TWISTING	7	46.70%	6	40.00%	X2=1.57	0.445
OVERUSE	5	33.30%	3	20.00%		
METAL WORK IRRITATION	1	6.70%	0	0.00%	X2= 1.03	0.30

SD: Standard Deviation. BMI: body math index. T: independent t test. X2: Chi square test.

There was no statistically significant difference regarding age, sex, smoking, side of the fracture, mechanism of injury and metal work irritation, (Table 1).

*Table 2. Results dispersion among the groups under investigation.*

	SURGICAL GROUP N=15		CONSERVATIVE GROUP N=15		TEST OF SIGNIFICANCE	P-VALUE
	mean	±SD	mean	±SD		
BONE UNION TIME(WEEKS)	11.8	0.9	14.8	3.4	T=3.256	0.003
RETURN TO ACTIVITY TIME(WEEKS)	11.2	0.9	12.5	1.3	T= 3.18	0.003
PARTIAL WEIGHT BEARING(WEEKS)	1.7	0.7	2.3	0.7	T=2.302	0.029
FULL WEIGHT BEARING(WEEKS)	5.1	1.1	6.1	1.2	T=2.42	0.022
ANKLE ROM(WEEKS)	2.3	0.5	6.4	0.7	T=17.823	$\leq 0.001$

With respect to ankle range of motion, partial weight bearing, complete weight bearing, and time to bone union, the conservative group significantly outperformed the surgical group, (Table 2).

*Table 3. Distribution of complications between the studied groups.*

	SURGICAL GROUP N=15		CONSERVATIVE GROUP N=15		TEST OF SIGNIFICANCE	P-VALUE
	N	%	N	%		
NO COMPLICATION	15	100%	11	73.30%	X2=4.61	0.03
DELAYED UNIONS	0	0%	3	20.00%		
MALUNION	0	0.00%	1	6.70%		

In terms of delayed unions and malunion, the conservative group had a statistically significant increase compared to the surgical group, (Table 3).

#### Case presentation:

##### Case 1:

Forty-four years old female patient with right side twisting injury closed fracture/neurovascular intact treated operatively with intramedullary screw fixation.



Figure 1. Preoperative x ray.



Figure 2. 12 weeks postoperative.

##### Case 2:

Thirty-eight years old male patient with right side twisting injury closed fracture/neurovascular intact treated conservatively with below knee plaster cast.





Figure 3. x-ray at the time of the fracture.



Figure 4. 12 weeks x-ray.

#### 4. Discussion

A common injury that foot and ankle surgeons often see is a fifth metatarsal fracture. Moreover, more than half of all metatarsal fractures are these types of breaks, and about 20% of fifth metatarsal fractures involve the diaphysis.<sup>9</sup>

According to some accounts, these breaks occur when the plantarflexed foot is subjected to strong reactive forces from the ground, which act on the metatarsal head and neck. A spiral or oblique fracture can occur at the base of the metatarsal due to the strong ligamentous attachments that provide a triplanar rotational force.<sup>10</sup>

Age, sex, smoking status, fracture side, injury mechanism, and metal work irritation were not significantly different among patients in this study.

Our findings were consistent with those of Pongpinyopap et al.,<sup>11</sup> who looked into the results and side effects of treating displaced diaphyseal fractures of the fifth metatarsal bone conservatively vs surgically. Participants had to be 18 years old or older and had fifth metatarsal diaphysis fractures that were closed and isolated. Twenty patients were implanted with a stent (surgical group) and twenty-five were left untreated (conservative group). They also discovered no statistically significant variations in demographic information between the two sets

of participants, just as we did.

After comparing the conservative and surgical groups, we found that the former had significantly better results in terms of bone union time, time to activity, partial weight bearing, full weight bearing, and ankle range of motion.

Our findings align with those of Jones et al.,<sup>12</sup> in addition to contrasting surgical and non-surgical approaches to treating distal fifth metatarsal diaphyseal fractures in individuals who were athletes and those who were not. The average time it took for patients to heal after surgery was 8.2 weeks, 13.5 weeks according to radiographs, and 12.9 weeks before they could resume their normal activities. The conservative therapy group, on the other hand, had lengthier mean times: 16.3 weeks for clinical union, 25.2 weeks for radiographic union, and 20.7 weeks for return to activity. Jones et al.,<sup>12</sup> determined that, when compared to conservative treatment, surgical intervention considerably shortened the duration to clinical and radiographic union and return to activity, on average, by eight weeks. Consistent with our own findings, these data provide more evidence that surgical intervention can speed up recovery in cases when the fracture is identical.

Our results were also consistent with those of Pongpinyopap et al.,<sup>11</sup> The average time it took for the ORIF group to become back to doing ADLs was  $8.6 \pm 3.1$  weeks, which is significantly faster than the casting group's  $16.0 \pm 4.18$  weeks ( $p < 0.001$ ), and the average time it took for the ORIF group to become back to union was  $8.7 \pm 1.8$  weeks, which is also significantly shorter.

Delayed unions and malunion were more common in the conservative group compared to the surgical group, according to our results.

Jones et al.,<sup>12</sup> compared to the surgical group, which did not have any problems such as delayed unions or nonunions; nevertheless, 27% of patients treated conservatively did.

In addition, we found results that were consistent with Pongpinyopap et al.,<sup>11</sup> The casting group had a considerably greater rate of problems reported by patients (28%,  $p < 0.05$ ), including painful malunion (12%), delayed union (8%), and persistent discomfort from complex regional pain syndrome (CRPS) (8%).

Our results showed that the surgical group had a significantly higher foot and ankle disability index than the conservative group. Additionally, the surgical group showed a statistically significant gain compared to the conservative group in terms of the American Foot and Ankle Score. Two randomized controlled trials that compared minimally invasive surgical procedures to conservative measures (such as immobilization and non-weight bearing) corroborated our

findings.<sup>12</sup>

Similarly, Lee et al.,<sup>13</sup> They included 29 participants in their investigation. In Group A, all fractures with gaps less than 2mm were treated conservatively. In Groups B and C, an equal number of patients with gaps more than 2 mm were treated either surgically or conservatively. Regardless of the initial fracture gap or style of therapy, they showed that radiographic union of all instances was associated with a significant decrease in AOFAS scores.

Limitations: The small sample size, the short periods of follow-up, and the single-center study are the limitations that face the study.

#### 4. Conclusion

Surgical treatment generally offers superior outcomes in terms of faster recovery, reduced complications, and overall lower disability. These findings suggest that surgical intervention is often preferable for achieving quicker and more reliable recovery, although treatment decisions should be individualized based on patient-specific factors and desired outcomes.

#### Disclosure

The authors have no financial interest to declare in relation to the content of this article.

#### Authorship

All authors have a substantial contribution to the article

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