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The outcome of cannulated cancellous screw fixation for treatment of base of fifth metatarsal fractures

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ABSTRACT

Background: The fracture of the base of the fifth metatarsal is one of the common fractures that occur in 5th decade of life in the foot. Stable fixation with the cannulated cancellous screw provided early healing and patients can return to their work early. **Aims and Objectives:** The aim of the study is to find the functional outcome of closed reduction and internal fixation with cannulated cancellous screw fixation for the displaced base of fifth metatarsal fractures, to evaluate the clinical and radiological union of fifth metatarsal fractures, and to study the complications of treatment of fifth metatarsal fractures. **Materials and Methods:** This prospective study was conducted in the Department of Orthopaedics Manipal teaching hospital Pokhara, Nepal, from February 2022 to January 2023. A total of 35 patients with the fractured fifth metatarsal base were included in the study. The patient was kept in a supine position with a pillow under the knee so that the knee was flexed to 90° and the foot was plantigrade. A cannulated cancellous screw of the appropriate size was inserted along with a washer to fix the fracture. **Results:** There were a total of 35 patients with the base of 5th metatarsal fractures. The mean age of the patient was 36.94 ± 8.04 years, with males 22 (62.9%) and females 13 (37.1%). The left side commonly involves 22 (62.9%). The history twisting injury is the most common mode of injury. All patients had a union of fracture by 7.09 ± 1.07 weeks ranging from 6 to 9 weeks. There were no cases of sural nerve injuries in our study. **Conclusion:** The base of fifth metatarsal fractures is commonly seen in athletes and patients around 40 years of age. Closed reduction under image guidance and stable fixation with cannulated cancellous screw fixation provides early healing of fractures. Patients can return to work early.

Key words: Metatarsal fracture; Fifth metatarsal; Cannulated screw; Percutaneous fixation

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INTRODUCTION

A fifth metatarsal fracture is a common fracture of the forefoot that occurs among athletes. It accounts for 5–6% of the fractures of the foot.[1] The peak incidence of fifth metatarsal fractures is seen in men below 40 years of age. In contrast, most women older than 50 years are affected.[2] There are different modalities of treatment for fifth metatarsal fractures. We studied the outcome of treatment with cannulated cancellous screw fixation.[3]

The fifth metatarsal bone plays an important role in maintaining the longitudinal and transverse arch. It also aids in the absorption of weight-bearing force in the lateral aspect of the foot. It is difficult to achieve anatomical reduction and maintenance of displaced fractures, because the peroneus brevis, peroneus tertius, and lateral plantar fascia exert constant traction force on the base of the fifth metatarsal.[4,5]

Cannulated screw fixation is the most common fixation method as it restores biomechanical force transduction

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from tendon to bone, leading to good healing. Stable fixation and early weight-bearing are possible from the rigid and stable fixation that is achieved by it, which is the demand of young patients and athletes.[6-9]

Aims and objectives

The aims of this study were as follows:

- The aim of the study is to find the functional outcome of closed reduction and internal fixation with cannulated cancellous screw fixation for the displaced base of fifth metatarsal fractures
- To evaluate the clinical and radiological union of fifth metatarsal fractures
- To study the complications of treatment of fifth metatarsal fractures.

MATERIALS AND METHODS

It is a prospective study conducted in the Department of Orthopedics Manipal teaching hospital Pokhara, Nepal, from February 2022 to January 2023. A total of 35 patients with the fractured fifth metatarsal base were included in the study.

Inclusion criteria

The following criteria were included in the study:

- Patients aged 16 and over with a displaced base of the fifth metatarsal fracture were included in the study.

Exclusion criteria

The following criteria were excluded from the study:

- Age below 16 years, open fractures, multiple comminuted fractures, osteoporotic fractures, and older fractures of more than 2 weeks were excluded from the study.

Operative procedure

All patients were treated under spinal anesthesia. The patient was kept in a supine position with a pillow under the knee so that the knee was flexed to 90° and the foot was plantigrade.

Under aseptic precaution, a 3–5 cm longitudinal incision was made along the base of the fifth metatarsal. The forefoot was kept in an adducted position, and two sural nerve branches were protected. Afterward, the tuberosity of the fifth metatarsal was identified and a guidewire was inserted after reducing the displaced fragments. The image intensifier confirmed the reduction. The drill was carried out using a cannulated drill bit under image guidance. A cannulated cancellous screw of the appropriate size was inserted along with a washer to fix the fracture as shown in Figure 1. The wound was stitched and the plaster slab was applied.

Post-operative rehabilitation

In the post-operative period, the patient's leg was elevated. For 48 h, the antibiotic ceftriaxone 1 g was administered intravenously. Isometric quadriceps exercise and calf stretching exercises were advised. The dressing was done on the 3rd day and the patients were discharged. Stitches were removed on the 14th post-operative day. Partial weight-bearing starts in the 3rd week, along with the plaster slab. The plaster was removed in 6–8 weeks. Patients were followed up for 3 months. The VAS FA score was calculated at 6 weeks and 3 months. Similarly, the AOF and A score (AOFAS) was calculated at 6 weeks and 3 months.

The clinical union was defined as a non-tenderer fracture site and no pain during weight-bearing and ambulation. Radiographic union was defined as the presence of new bone formation with bridging trabeculae across the fracture site. Here, we evaluate all patients' clinical and radiological outcomes at 6 weeks and 3 months. Complications of internal fixations like infection, failure of fixation, and non-union were noted.

Informed consent

- Informed verbal and written (both in English and Nepali language) consent was taken from all patient guardian.

RESULTS

A total of 35 patients who met the inclusion criteria were included in the study. Demographic profiles are shown in Table 1.

The most common mechanism of injury was twisting injury, followed by direct trauma and other injuries like falling on the ground while playing. Twelve patients had associated injuries, two had head injuries, four had upper limb injuries, and six had lower limb injuries. The most common fracture is transverse fracture; other fracture features are there in Table 2.

All fractures were united clinically and radiologically. The time to unite the fracture, time to full weight bearing, return to normal activity, AOFAS score, and vas score are demonstrated in Table 3. Patients were able to bear weight and mobilized at 6 weeks, the fracture healed on an average of 7 weeks. All wounds healed in 14 days. All patients had a good outcome and by 8 weeks most of the patients returned to their normal work. No sural nerve injury and no infection were seen in our study. There was implant prominence in two cases.

Table 1: Demographic variable

Variables	Results
Age of patients	36.94±8.04 (24–54 years)
Patient's gender	
Male	22 (62.9%)
Female	13 (37.1%)

Table 2: Fracture features

Variables	Number of cases	Percentage
Mechanism of injury		
Twisting injuries	19	54.3
Sport injuries	4	11.4
Direct trauma	7	20.0
Fall form height	5	14.3
Side of fracture		
Right	13	37.1
Left	22	62.9
Torg anatomical classification		
Zone I	12	34.29
Zone II	15	42.86
Zone III	8	22.85

Table 3: The outcomes of the patients

Parameters	Numbers or Mean±SD	Range
Time of union of fracture (weeks)	7.09±1.07	6–9 weeks
Time of full weight-bearing (weeks)	6.14±0.69	5–9 weeks
Return to work (weeks)	7.80±0.72	6–9 weeks
AOFAS at 6 weeks	77.06±5.95	68–88
AOFAS at 3 months	88.20±3.87	79–95
VAS at 6 weeks	1.89±0.79	1–4
VAS at 3 months	0.54±0.56	0–2

AOFAS: AOF and A score

DISCUSSION

The base of the fifth metatarsal is located on the lateral side of the foot. The proximal portion, of the fifth metatarsal, articulates medially with the fourth metatarsal, while the tuberosity articulates proximally with the cuboid. Strong ligaments attach the fifth metatarsal to these two bones. The lateral band of the plantar fascia attaches to the plantar aspect and the peroneus brevis tendon attaches to the lateral aspect of the tuberosity. The traction force by these structures during inversion injuries causes avulsion fracture of the 5th metatarsal.[10]

There is a lack of randomized controlled trials regarding treatments of displaced fifth metatarsal fractures. Most of the time zone type I fractures are treated none operatively; however, surgical treatments were considered for active athletes. Here, we studied the outcome of surgical treatment of fifth metatarsal fractures. In our study, all patients with displaced fifth metatarsal fractures were treated with surgical methods.

Figure 1: Preoperative (a), Intraoperative (b, c), and final x-ray showing the union of a base of 5th Metatarsal fracture (d)

Surgery is needed for 2 mm displacement with 30° angulation of the fractured base of the fifth metatarsal. The study of Zwitser and Breederveld[11] mentions surgery is mandatory for the correction of displacement, angulation, rotation, and maintaining the length.

In our study, all patients with fifth metatarsal fractures were treated with percutaneous cannulated screw fixation. All our 35 patients had an excellent outcome with fracture union at an average of 7 weeks which is similar to the study of Bušková et al., Murawski and Kennedy and de Oliveira Massada et al.[3,7,8] They were able to return to their work by 8 weeks. Minimal invasive surgery and compression at the fracture site helped in early healing with no evidence of nonunion in our study.

The most accepted technique for non-union is open reduction curettage of the nonunion site followed by intramedullary fixation with a screw.[12] In our study, we treated the acute cases with the percutaneous cannulated screw. Here, we did not open the fracture site. All cases were done by percutaneous methods. This helped in the prevention of blood supply, thus helping in the early healing with no evidence of nonunion in our study. The surgery helps in the early healing of the fracture and allows patients to return back to their work, which is similar to the study of Torg et al.,[13] and other studies.[14-17]

The disadvantage of plaster immobilization for a longer period is avoided by simple minimal invasive surgery, which gives good results with an average healing time of 7 weeks in our study, which is similar to the study of Low et al.,[18] and others.[9,14,19]

The cannulated screw placement is precise and easy. We passed the guide wire along the fracture site, confirmed in the image intensifier then only we did drilling and passed the screw over it. There is no added advantage of the solid screw or 6.5 mm screw over a 4 mm cannulated screw. The use of a larger diameter screw increases the risk of diaphyseal fractures.[20] The study of Pietropaoli et al.,[21] shows similar biomechanical strength of both cannulated and non-cannulated screw. Most of the studies used 4 or 4.5 mm cannulated screws because the canal diameter of the 5th metatarsal is between 2.2 and 5.9.[20] We used a 4 mm cannulated screw in our study. The advantage of cannulated screw fixation and proper placement of the screw might be the cause for a better outcome in our study. The small diameter of the diaphysis and the use of a larger screw may cause distraction of fracture[14] which is not seen in our study.

In our study, post-operative non-weight-bearing mobilization was done for 1–2 weeks. After that, we started weight-bearing along with a cast for 4–6 weeks. That might be the reason for the early mobilization, with no pain with an excellent AOFAS score by 3 months.

In our study, the AOFA and VAS score was better after 3 months of surgery. Patients had an excellent outcome which is similar to the study of Wu et al.,[8,22] who demonstrate a 100% union rate by the use of cannulated screws for displaced fifth metatarsal fractures with an average union time of 6–8 weeks.

In our case all patients, we used a partially threaded cannulated screw, the threaded slot was completely in a distal fragment to achieve compression of the fracture. We confirmed each case in the image intensifier. This might be the reason for the healing of all cases without any evidence of non-union in our cases.

The main disadvantage of intramedullary screw fixation is the risk of irritation of the sural nerve, and symptomatic prominence of the screw head.[4,5,14] Proper planning and surgical technique helps to avoid these complications. No patients had sural nerve injuries in our study.

Regarding the complication, there was no non-union or malunion in our study. There were two cases of implant prominence seen in our study. These two patients who were thin-built had a screw prominence. This problem was solved after the removal of the screw. None of the patients had sural nerve injury and post-operative infection. Percutaneous surgery, done meticulously may be the reason for the better outcome. A similar comparative study was done by Kc et al.,[5] in which all fractures were united, in which operative treatment was done for the displaced base of 5th metatarsal fractures with no other complication.

Limitations of the study

The limitation of the study was the small sample size. Furthermore, long-term clinical and radiological results were not part of the study. There was no comparison with other modalities of treatment.

CONCLUSION

Operative management of displaced fifth metatarsal fractures helps in early healing. Due to faster, clinical healing patients return to work early. There is no non-union seen in our study so the treatment is not only recommended for athletes and high-demand patients but also for all patients for better and excellent results.

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