Comparative Study between Operative versus Non-operative Treatment for Base of Fifth Metatarsal Fractures in Young Adults

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Citation

KC KM, Marahatta SB, Niroula A, KC A, Pangeni RB. Comparative Study between Operative versus Non-operative Treatment for Base of Fifth Metatarsal Fractures in Young Adults. *Kathmandu Univ Med J.* 2021;74(2):190-4.

ABSTRACT

Background

The treatment of displaced base of fifth metatarsal fracture remains controversial regarding the conservative and operative treatment.

Objective

To investigate the therapeutic effect of operative and non-operative treatment for base of fifth metatarsal fractures.

Method

This was retrospective comparative study performed in Civil Service Hospital, Kathmandu, Nepal from December 2014 to November 2019. Patients were randomly divided into two groups by computer generated technique. Group1 included 17 patients who underwent open reduction and internal fixation using tension band wiring, whereas group 2 included 17 patients who underwent non-operative treatment with boot cast.

Result

The AOFAS and VAS-FA scores at 3 months in operative and non-operative groups were 89.34±2.14 versus 86.94±2.22 ($p < 0.05$) and 5.58±0.87 versus 3.58±0.93 ($p < 0.05$). Similarly, AOFAS and VAS-FA at 12 months after treatment were 90.94±2.43 versus 90.17±1.55 ($p > 0.05$) and 0.64±0.280.94±0.39 ($p > 0.05$) in operative and non-operative groups respectively. The average time to bear full weight and return to work were 6.82±1.13 versus 7.08±1.24 weeks ($p > 0.05$) and 8.76±1.20 versus 10.35±1.41 weeks ($p < 0.05$) respectively. The mean of VAS score at 3months of treatment is 5.58±0.87 for non-operative group and 3.58±0.93 for operative group ($p <0.05$).

Conclusion

Operative intervention has been preferred over the non-operative treatment in young adults or athletes with more than 3 mm displaced fifth metatarsal base fracture to achieve anatomical reduction of fracture, hasten the recovery and rehabilitation and to decrease the complications associated with non-operative treatment.

KEY WORDS

Comparison, Fifth metatarsal fracture, Non-operative treatment, Operative treatment, Tension band wiring

INTRODUCTION

Base of fifth metatarsal fracture (FMF) is considered one of the common fractures of the forefoot occurring especially in athletes and mechanism of injury is believed to be an abduction force on the forefoot with simultaneous ankle plantar flexion.[1-4] Torg classified the proximal FMF into three types: type 1–fracture on the lateral aspect of the tuberosity, extending proximal to the metatarso-cuboid joint (pseud-jones fracture); 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 (jones fracture); and type 3–fracture distal to the fourth and fifth metatarsal base articulation.[5]

The fifth metatarsal bone is an important part of both longitudinal and transverse arch of foot and plays a vital role for appropriate function of both arches as well as buffering the weight bearing force in lateral aspect of foot. Since peroneus brevis, peroneus tertius and lateral plantar fascia execute the constant traction force on the base of fifth metatarsal, it is difficult to achieve the anatomical reduction and maintenance of displaced base of type I and II FMF with conservative treatment. Nevertheless, majority of displaced base of FMF are treated by conservative methods, however post-treatment evaluation of conservative treatment is scanty.[6] Several studies had demonstrated that conservative treatment with boot cast give the satisfactory results while some other studies mentioned that surgical treatment produce better functional outcomes.[7-17] In the recent days, treatment approach to base of FMF has largely been influenced by expectation of early return to work especially in athletes and young adults. Increased incidence of malunion, fibrous union, re-fracture and delayed return to work in non-operative treatment has motivated for both patients and surgeons to primarily fix the fractures.[17,18]

The aim of this study is to investigate the functional outcomes of open reduction and internal fixation with tension band wiring (TBW) for displaced type I and II base of fifth metatarsal fractures comparing with application of boot cast.

METHODS

This was a retrospective comparative study based on hospital record in department of orthopedics, Civil Service Hospital, Kathmandu, Nepal from December 2014 to November 2019. A total of 39 type I and II displaced fifth metatarsal base fractures were treated operatively and non-operatively during this period, however 5 patients were lost during the follow up and finally included 34 patients in this study. Out of 34 patients, 14 were type I and 20 were type II varieties in both groups. Among 14 type I fractures, 8 were in conservative group and 6 were in operative group. Similarly among 20 type II fractures, 9 were in group I and 11 were in group II. Permission for the study was taken from the institutional review board of our hospital and informed written consent from each patient was taken to participate in the study. All the surgeries were performed by corresponding author either independently or jointly. Thirty-four patients were divided into two groups by computer generated technique. Patients with odd number were included in group I and those with even number were included in group II. Group 1 included 17 patients who underwent open reduction and internal fixation using tension band wiring, whereas group 2 included 17 patients who underwent non-operative treatment with boot cast. If a patient did not agree to enter the corresponding group, the patient was excluded from this study.

Patients of age 16 to 45 years with type I and II base of fifth metatarsal fractures and those with less than 4 mm displacement and less than 10 degree angulation were included in the study while those with type III varieties, more than or equal to 4 mm displacement and 10 degree angulation, age below 16 and above 45 years, open fractures, multiple and comminuted fractures, osteoporotic fractures, more than 2 weeks old and with diabetes mellitus were excluded from the study.

Conservative method

Antero-posterior (AP), oblique and lateral views radiographs were done in all cases (fig. 1-3). Patients in non-operative group were immobilized with a posterior slab at neutral position for one week to subside the swelling followed by short leg cast or boot cast until fracture healing had completed. Patients were allowed to do partial weight bearing 2 weeks after fracture while moderate movement of the knee and hip were encouraged to avoid venous thrombosis and musculoskeletal atrophy of lower extremity during initial immobilization period. Clinical union was defined as a non-tender fracture site, the absence of pain with ambulation, and radiographic evidence of fracture healing. Radiographic union was defined as the presence of new bone formation with bridging trabeculae across the fracture site. Patients were allowed to return to normal activity and sports participation after clinical union of the fracture.

Figure 1. Antero-posterior and oblique views of foot showing displaced base of fifth metatarsal fracture

Figure 2. Antero-posterior and oblique views of foot one year after operative treatment with tension band wiring.

Figure 3. Showing antero-posterior and oblique views of with application of posterior slab.

Surgical technique

Patients were kept supine position with bolster under the gluteal region of affected limb to maintain the internal rotation of foot. After spinal anesthesia or ankle block was given, pneumatic tourniquet was applied and primary scrubbing was done. With strict aseptic precaution, around 3 to 4 cm long incision was made along base of fifth metatarsal with a surgical blade. Forefoot was maintained in adducted position to facilitate the exposure while special attention was given to protect the two branches of sural nerve. After identification of tuberosity and the base of the fifth metatarsal, fracture was reduced and fixed with tension band wiring. The wound was closed with stitches of non-absorbable suture. Posterior slab was applied at neutral position at the end of surgery.

Postoperative rehabilitation

In the post-operative period, limbs were elevated. Intravenous antibiotic was given for three days. Isometric quadriceps, calf muscle strengthening, knee and hip mobilization exercises were started from the second day after surgery. Stitches were removed 2 weeks after surgery and partial weight bearing with bilateral axillary crutches was started 3 weeks after surgery.

For both the groups, return to normal work was allowed when the clinical and radiological union was seen. All patients were followed up in the outdoor department at monthly intervals for 6 months and then at 1 year. VAS-FA score was calculated in both groups at 3 months and 1 year. Similarly American Orthopedic Foot and ankle (AOFAS) score was calculated at 3 months and one year after treatment to assess the functional outcomes in both groups.

Statistical analysis:

Statistical analysis was done using statistical software SPSS (version 16.0). The descriptive statistics were used to calculate mean and median values, Standard Deviation (95% confidence interval) while continuous variables were compared by applying Student's t test. The p value < 0.05 was considered as statistically significant.

RESULTS

Thirty four patients were followed up for 12 months. Demographic parameters of both groups were demonstrated in table 1 while AOFAS score, VAS-FA score, time to unite the fracture, time to full weight bearing and return to normal activities were demonstrated in table 2. All fractures in both groups were united except for two patients in non-operative group with malunion, one of whom had frequent mild to moderate plantar pain. However union rates of type I and II in both nonoperative and operative groups were similar. No sural nerve injury and post-operative infection were found in operative group except 2 cases of implant prominence.

Table 1. Showing demographic profiles of patients in both group

Demographic parameters	Group 1 Conservative treatment	Group 2 Operative treatment
Age (years)	31.41±7.14	30.35±6.68
Sex		
Male	10	11
Female	7	6
Mechanism of injury		
Twisting injury	12	13
Sports injury	3	4
Direct injury	2	0
Side		
Right	5	6
Left	12	11

DISCUSSION

Optimal management of displaced base of FMF still remains controversial. If these fractures remain displaced during treatment, it may result in delayed union, malunion and even nonunion that may cause abnormal distribution of plantar pressure and alter the function of midfoot. Heineck

Table 2. Showing different characteristics in both groups of patient.

Parameters	Group 1 Conservative treatment	Group 2 Operative treatment	P value
Time to unite the fracture (weeks)	8.88±1.16	8.11±0.99	>0.05
AOFAS score at 3 months	86.94±2.22	89.34±2.14	<0.05
AOFAS score at 12 months	90.17±1.55	90.94±2.43	>0.05
VAS-FA score before treatment	6.8±0.97	6.5±0.85	>0.05
VAS-FA score after 3 months	5.58±0.87	3.58±0.93	<0.05
VAS-FAS score after 12 months	0.94±0.39	0.64±0.28	>0.05
Time to full weight bearing (Weeks)	7.08±1.24	6.82±1.13	>0.05
Return to work (Weeks)	10.35±1.41	8.76±1.20	<0.05
Malunion	2	0	
Implant prominence	0	2	

et al. demonstrated that surgical treatment is mandatory in case of base of FMF when fracture gap is more than 2 mm and articular surface involvement is more than 30 percent.[4] The study of Zwitser et al. also showed the similar finding where surgical treatment is necessary when fracture displacement is more than 2 mm with or without more than 30 percent involvement of articular surface of base of fifth metatarsal.[19] Both of these studies showed that operative intervention correct the displacement, angulation, rotational deformity that maintain the length of fifth metatarsal and stabilization of insertions of both ligaments and tendons.

In this study, therapeutic effects were compared between open reduction and fixation with tension band wiring and conservative treatment with boot cast. The AOFAS and VAS-FA at 3 months after treatments were significantly better in the operative group 89.34±2.14 versus 86.94±2.22 ($p < 0.05$) and 5.58±0.87 versus 3.58±0.93 ($p < 0.05$). The average time to bear full weight and to return to work was also shorter in operative group 6.82±1.13 versus 7.08±1.24 weeks ($p > 0.05$) and 8.76±1.20 versus 10.35±1.41 weeks ($p < 0.05$). However, AOFAS and VAS-FA at 12 months after treatment showed no significant difference 90.94±2.43 versus 90.17±1.55 ($p > 0.05$) and 0.64±0.280.94±0.39 ($p > 0.05$) in operative and non-operative groups respectively. Time to full weight bearing was shorter in operative group, even though it is not statistically significant, 6.82±1.13 versus 7.08±1.24 weeks ($p > 0.05$), and return to normal work is also shorter and statistically significant in operative group compared to conservative group (8.76±1.20 versus 10.35±1.41 p value < 0.05). Based on these results our recommendation for displaced base of FMF in young adults and elite athletes is to treat the fracture surgically. However same recommendation may not be applied for older patients because AOFAS and VAS-FA scores at 12 months after treatment in both groups were similar. Similarly choice of treatment also depends on the individualized basis as there are long list of exclusion criteria in our study.

The study of Wu et al. was similar to the current study.[20] Their report showed that operative management of displaced fifth metatarsal zone I avulsion fractures in young adults or athletes can result in better outcomes in short-term compared with conservative treatment. Although the AOFAS scores at 12 months after treatments showed no significant difference between surgical and conservative management, non-operative management may increase the incidence of post-trauma complications including delayed union, malunion, nonunion, re-fracture, pain, and even malfunction of mid-foot. Besides, surgical treatment allowed patients earlier full weight bearing and return to work. They had used 3.0 mm cannulated screw to fix the fracture, for which they mentioned the novel minimally invasive surgical technique. With the utilization of point reduction clamp in surgery, only an incision of 1 cm could be made and a cannulated screw of 3.0 mm was tapped thereafter, which could save the blood supply of metatarsal. In addition, cannulated screw can offer certain compression at fracture site to maintain anatomic reduction, all of which provided a good condition for bone union and allowed for early rehabilitation exercises.[20] Even though we had not separated the small fragment and large fragment fractures separately in our study, we agree with Wu et al. with use of cannulated screw for surgical fixation of the fracture, however we prefer open reduction and TBW for type I and II varieties because fracture fragment may be very small occasionally which could be easily broken with screw insertion.[20] However we fully agree with use of cannulated screw for type III fractures because of larger fracture fragment and tendency of increased non-union in these fractures.

There is no significant difference of visual analogue pain score before treatment between the two groups. The mean VAS before treatment is 6.8±0.97 versus 6.5±0.85 for non-operative and operative group respectively (p value > 0.05). But there is a significant difference of the VAS score at 3 months of treatment. The mean VAS is 5.58±0.87 for non-operative group and 3.58±0.93 for operative group with p value < 0.05. This indicates that there is high success rate and quicker union in surgery group compared with that of cast group. Our results are also similar with the study of Leumann et al. where 14 patients had excellent results out of 22 without fair or poor results.[21]

In the current study time to unite the fracture was 8.88±1.16 weeks in cast group and 8.11±0.99 weeks in operative group which is not statistically significant with p value more than 0.05. Our result in terms of time to unite the fracture is conflicting to other studies. In the comparative study done by Timothy et al. the mean time to clinical union in cast group is 14.5 weeks and 6.3 weeks in surgery group.[22]

In another study, only screw fixation done by Kery Resse et al showed mean time for clinical union is 7.3 weeks and return to normal activity is 7.9 weeks, which is somewhat comparable with our results.[22]

Regarding the complications, there were only two patients of fracture malunion in non-operative group in our study out of whom one had frequent foot pain while walking on the ground. Similarly there were two cases of implant prominence in the operative group, however sural nerve injury and postoperative infection were not seen. Kavanaugh et al. in their series mentioned that union was delayed in twelve of 18 fractures that were treated conservatively.[13] In their total group of 23 fractures, 13 were eventually treated surgically using an intra-medullary screw for fixation.[13] Similarly comparative study done by Mologne et al. demonstrated that 8 of 18 (44%) resulted in treatment failures (5 non-union, 1 delayed union, and 2 re-fractures) in cast group.[22]

CONCLUSION

Surgical intervention is preferred over non-operative treatment in young adults or athletes with more than 3 mm displaced fifth metatarsal base fracture to achieve anatomical reduction of fracture, hasten the recovery and rehabilitation and to decrease the complications associated with non-operative treatment. Open reduction with tension band wiring is an effective way to treat the fifth metatarsal base fracture.

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