MINIMAL INVASIVE PLATE OSTEOSYNTHESIS- AN EFFECTIVE TREATMENT METHOD FOR DISTAL TIBIA INTRAARTICULAR (PILON) FRACTURES- AN 18 MONTHS FOLLOW UP

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ABSTRACT

BACKGROUND

Tibial pilon fracture though requires operative treatment is difficult to manage. Conventional osteosynthesis is not suitable, because distal tibia is subcutaneous bone with poor vascularity. Closed reduction and Minimally Invasive Plate Osteosynthesis (MIPO) for distal tibia has emerged as an alternative treatment option because it respects fracture biology and haematoma and also provides biomechanically stable construct.

The aim of the study is to evaluate the results of minimally invasive plate osteosynthesis using locking plates in treating tibial pilon fractures in terms of fracture union, restoration of ankle function and complications.

MATERIALS AND METHODS

30 patients with closed tibial pilon fractures (Ruedi and Allgower type I (14), type II (13), type III (3) treated with MIPO with Locking Compression Plates (LCP) were prospectively followed for average duration of 18 months.

RESULTS

Average duration of injury-hospital and injury-surgery interval was as 12.05 hrs. and 3.50 days, respectively. All fractures got united with an average duration of 20.8 weeks (range 14-28 weeks). Olerud and Molander score was used for evaluation at 3 months, 6 months and 18 months. One patient had union with valgus angulation of 15 degrees, but no nonunion was found.

CONCLUSION

The present study shows that MIPO with LCP is an effective treatment method in terms of union time and complications rate for tibial pilon fracture promoting early union and early weight bearing.

KEYWORDS

Tibial Pilon, Intraarticular, MIPO, Locking, Olerud and Molander.

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BACKGROUND

A pilon fracture also called a plafond fracture is a fracture of the distal part of the tibia involving its articular surface at the ankle joint. Pilon is the French word for pestle and was introduced into orthopaedic literature in 1911 by pioneer French radiologist Etienne Destot.[1]

Pilon fractures are caused by rotational or axial forces, mostly as a result of falls from a height or motor vehicle accidents. Pilon fractures comprises 3 to 10 percent of all fractures of the tibia and 1 percent of all lower extremity fractures,[2] but they involve a large part of the weight bearing surface of the tibia in the ankle joint. With this type of injury, the other bone in the lower leg, the fibula is frequently broken as well.

The treatment of pilon fractures depends on the extent of the injury. Thorough assessment including soft tissue involvement and immediate joint reduction are the cornerstones of care prior to surgical treatment determination.

The surgical treatment of fractures has evolved a great deal since the development of the original "open reduction and internal fixation" technique by the AO group, even though high rates of complications have been reported in literature with conventional methods.[3-5] Nowadays, plating with MIPO technique has evolved as an excellent method of tibial pilon fracture fixation, which causes minimal dissection and surgical trauma to the bone and surrounding soft tissues.[6]

Inclusion Criteria

Closed fractures and age ≥20 years.

Exclusion Criteria

Compound fractures, pathological fractures, fractures with vascular injuries and nerve injuries.

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MATERIALS AND METHODS

Satisfying selection criteria, thirty patients with closed tibial pilon fractures treated in the centre between April 2014 to April 2015 were selected and prospectively followed. Patient details, mode of injury, injury-hospital and injury-surgery interval, functional analysis at 3 months, 6 months and 18 months and time required for union were recorded. Fracture was classified according to Ruedi and Allgower[3] classification system.

Preoperative Workup

Routine blood investigations and standard radiographs of the involved region were obtained in all patients.

Operative Technique

Under regional anaesthesia, involved limb was prepared and draped. Tourniquet was routinely applied and inflated unless contraindicated. A 3-4 cm longitudinal incision was made at the level of medial malleolus taking great care not to injure great saphenous vein and saphenous nerve. Epi periosteal plane was made without disturbing fracture haematoma using the implant or blunt dissector. Fracture reduction was checked under C-arm acceptable criteria for reduction were varus-valgus angulation <5° and Anterior-Posterior (AP) angulation <10° and shortening of <15 mm.

Precontoured distal tibia locking plate was slided thorough the incision proximally bridging the fracture site and at least three locking screws were applied on the other side of fracture through separate minimal incisions. If necessary, interfragmentary compression was achieved by a cortical screw through the plate or outside the plate. Fibula was fixed if involved at the level of syndesmosis. Skin was closed using non-absorbable sutures followed by below knee slab to splint the limb.

Postoperative Protocol

Wound was dressed on second and fifth postoperative day. Intravenous antibiotics were started followed by oral antibiotics till suture removal. Active range of movements of knee and ankle joint and quadriceps strengthening exercises were started on postoperative day one. Non-weight bearing gait was started initially if followed by partial weight bearing. Full weight bearing gait was started once considerable callus was visible on standard x-ray views during the follow up period. Olerud and Molander[7] score was used for functional evaluation of ankle joint at 3 months, 6 months and 18 months.

Fracture union was considered when considerable bridging callus was visible on AP and lateral x-rays of ankle with leg and absence of pain and movement at fracture site. Malunion was defined as varus-valgus angulation ≥5° and AP angulation ≥10° and shortening of ≥15 mm.

GraphPad Prism 7.00 for window was used for statistical analysis. Olerud and Molander test was used for comparison. A p value <0.05 was regarded as significant (p value-0.0068).

RESULTS

There were 19 males of mean age 34.76 years (range 21-56 yrs.) and 11 female patients of mean age 55.37 years (range 36-72 yrs.). 17 patients were less than 50 years of age and 13 were more than or equal to 50 years of age. According to Ruedi and Allgower classification, 14 (47%) of fracture were type I, 13 (43%) type II and 3 (10%) type III. 13 patients had associated fibular fractures of which 7 required fixation. 21 patients sustained injury in road traffic accident and 9 patients due to fall. Average duration of injury-hospital and injury-surgery interval was 12.05 hrs. (range 1-42 hrs.) and 2.50 days (range 1-4 days), respectively. Functional evaluation according to Olerud and Molander score[7] was done at 3 months, 6 months and 18 months and graph showing the average functional score is shown in Figure 1.

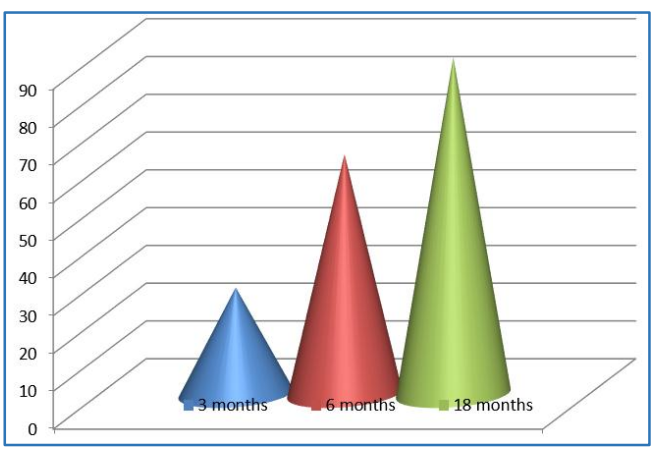

Figure 1. Graph Representing Average Functional Score at 3 Months, 6 Months and 18 Months

Average duration for fracture union was 20.8 weeks (range 15.5-39 weeks). Superficial wound infection was seen in two patient, which was managed with extended period of intravenous antibiotics. One patient had valgus malunion. No nonunion was detected. Two patients had ankle stiffness requiring extensive physiotherapy to regain range of movement.

Figure 2 shows the preoperative, postoperative and follow up x-rays of patient treated with MIPO with precontoured locking plate for tibial pilon fracture. Figure 3 shows the clinical image at final follow up.

Figure 2. Ruedi and Allgower type 1 Fracture. Pre and Postoperative (2.1, 2.2) and follow up at 3 Months (2.3), 6 Months (2.4) and 18 Months (2.5)

Figure 2.1. Preop X-Ray

Figure 2.2. Postop X-Ray

Figure 2.3. X-Ray at 3 Months Follow up

Figure 2.4. X-Ray at 6 Months Follow Up

Figure 2.5. X-Ray at 18 Months Follow Up

Figure 3. Clinical Images at Final Follow up

Figure 3.1. Clinical Images - Ankle Dorsiflexion

Figure 3.2. Clinical Images - Ankle Plantar Flexion

DISCUSSION

For quite some time, distal tibial fractures with or without intraarticular extension have been treated by open reduction and internal fixation with plates. The risk of disrupting blood supply is more with the classic approach of open reduction and internal fixation in the metaphyseal region of the tibia.[8,9] It also leads to serious complications of infection and wound breakdown with implant exposure.

Minimally invasive plating technique with precontoured locking plates causes less surgical trauma, preserves periosteal blood supply and osteogenic fracture haematoma and maintain anatomical and biological environment for fracture healing.[10] Closed reduction method and subcutaneous sliding of the plate and application of locking screws through small skin incisions in MIPO technique prevents iatrogenic injury to vascular supply of the bone.[10]

Ahmad et al (2012) in his study concluded that fixing distal tibial periarticular fractures with locking plates using MIPO showed higher fracture union rates with minimal complications and good functional recovery.[11] Arjun Ballal et al (2016)[12] in their prospective study on functional outcome of internal fixation of tibial pilon fractures with locking plate using minimally invasive plate osteosynthesis technique concluded that minimally invasive plate osteosynthesis is an excellent method of treating pilon fractures with very good functional results and minimal complication rate. Bedi et al[13] (2006) concluded that percutaneous plating techniques are preferred as conventional methods requires extensive soft tissue dissection and cause more periosteal damage, which hampers healing and increase the risk of complications. Mohamed Ali et al[14] in their study on 30 patients reported that after 5 years follow-up, MIPO was an excellent option for the challenging distal tibia fractures even with simple articular extension.

Because of subcutaneous location, distal one-fourth tibia fractures are prone to have gross swelling, skin injury and blisters if the leg is left unsupported for long time or if patient presents late. Our protocol for timing of surgery was to fix the fracture as early as possible unless hindered by gross swelling or blisters. 13 patients had injury-surgery interval of >=3 days. But, in our study, union time was not affected whether patients were operated before or after three days of injury.

The average time for fracture union in the present study is comparable to other studies. Table 1 shows comparison of our study with other studies. Patients less than 50 years of age showed better results in terms of union and functional recovery as compared to patients more than 50 years of age, which was statistically significant. Table 2.1 and 2.2 shows average union time and functional scores at regular follow ups.

Study	Number of Patients	Type of Study	Method Preferred	Average Time of Union (weeks)	Complications
Ronga M et al[15]	19	Retrospective	MIPO	22.3	Nonunion: 1 No malunion Deep infection: 3
A Ballal et al[11]	18	Prospective	MIPO	21.4	Superficial wound infection: 2 Deep wound infection: 1 Fixed equinus deformity: 1
Mohammad Ali et al[14]	30 (Open fracture-7)	Prospective	MIPO	22	Delayed union: 2 Nonunion: 0 Superficial wound infection: 3
Shrestha D et al[16]	20	Prospective	MIPO	18.5	Delayed union: 1 No malunion Superficial wound infection: 2 Deep infection: 1
Our study	30	Prospective	MIPO	20.36	Malunion: 1 Superficial wound infection: 2

Table 1. Comparison of Our Study with Other Studies

Age	Number of Patients	Average Union Time (Weeks)	P value (Unpaired t Test)
<50 Years	17	18	<0.05
>=50 Years	13	23.02	

Table 2.1

Age (Years)	Number of Patients	Average Olerud and Molander Score		
		3 Months	6 Months	18 Months
<50	17	27.62	66.29	91.26
>=50	13	24.5	59.91	83.17

Table 2.2

CONCLUSION

Tibial pilon fractures are one of the difficult fractures to treat with all currently available options. The fracture pattern, concomitant articular extension, soft tissue condition are important factors to be considered before selection of fixation method. The present case series shows that MIPO with locking plates is an effective treatment method in terms of both union time and complications rate, which is comparable to other studies. It promotes early union and facilitates early weight bearing. Especially, in cases of critical soft tissue injuries, it is of paramount importance for successful outcome.

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