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Original Research Article

Management of Tibial Pilon Fractures Using Delta External Fixator Method versus MIPO Technique: A Prospective Comparative Study

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Abstract:

Background: The treatment of Tibial Pilon fractures are one of the most dreaded of ankle joint fractures management, and they continue to pose a challenge to the orthopaedic surgeons. They are associated with extensive soft tissue damage, articular surface damage, and osseous comminution. The ideal treatment of these tibial pilon fractures is still a matter of debate.

Aim: The aim of this study was to study the management and assess the functional outcome of patients with tibial Pilon fractures treated by Delta External Fixator method versus MIPO technique.

Results: In our study, which included 30 patients with a follow up period of 1 year, outcome was excellent in the Delta External fixator group compared to MIPO group. Although the final AOFAS score and ROM were slightly less in Delta External fixator group. The time to weight bearing and time for radiological union were slightly shorter in Delta External fixator group than MIPO group of patients.

Keywords: Tibial pilon fracture, Delta external fixator, MIPO.

Introduction

Tibial Pilon fractures are one of the most severe ankle joint fractures, and they continue to pose a challenge to the orthopaedic surgeon. They are associated with extensive soft tissue damage, articular surface damage and osseous comminution and are frequently associated with high energy trauma [1].

The phrase 'distal tibial fracture,' according to the AO/OTA classification, refers to a diverse group of fractures involving the distal parts of both the tibia and the fibula. Etienne Destot coined the term "pilon fracture" to describe the involvement of the weight bearing surface of the ankle joint, which usually occurs due to an axially directed stress [2].

The pilon fracture is a comminuted distal tibia fracture. Etienne Destot initially used the term "pilon" in the orthopaedic literature in 1911, defining the anatomical region extending 5 cm proximal from the distal tibial joint line [3]. Pilon fractures account for 7% of all the tibial fractures and 1% to 10% of all the lower limb fractures. The fibula is fractured in 85% of high energy tibial pilon fractures [4]. These often occur as a result of falls from a great height or motor vehicle accidents.

The degree of trauma to the surrounding soft tissue envelope should not be underestimated; at this level of the lower limb, there is little muscle cover between the skin and the bone, and the energy of the injury is passed directly to these soft tissue components. Open fractures are most frequent, and even when there isn't an open injury, closed traumas can cause severe soft tissue injury [5].

In the treatment of distal tibial fractures, the main goal is to achieve proper alignment, length, and rotation in order to achieve a congruent joint, stable union and functionally mobile ankle joint. The literature describes various surgical and nonsurgical treatment approaches in treating the distal tibia fractures. However, since the range of tibial injuries is so wide, no single treatment strategy is appropriate for all the fracture patterns [6]. Currently, there is no level I evidence for optimum management of tibial pilon fractures using both internal and external fixation procedures, either alone or in combination [8].

The severity of the soft tissue injury, the fracture pattern, and the treating surgeon's experience are the factors that influence the treatment options [7].

Materials and Methods

A prospective comparative study was carried out at the Department of Orthopaedics, KoIMS, Madikeri, and Karnataka. Thirty patients were included in the study with a follow up period of 1 year. The fractures were classified using AO classification system. Open fractures were classified according to Gustillo-Anderson classification and soft tissue condition on presentation was classified using Oestern and Tscherne classification. The outcome was graded using AOFAS scoring system and ankle ROM assessment. The trauma to surgery interval was 3–7 days.

Inclusion Criteria:

- Age >18 years
- AO Classification-Distal Tibial intra-articular fractures
- Patients medically fit for surgery

Exclusion Criteria:

- Patients <18 years of age
- Patients medically unfit for surgery
- Associated vascular injuries
- Pathological fractures

MIPO Technique Group

After written informed consent, the patients were operated under spinal anaesthesia. A Pneumatic tourniquet was applied in the upper thigh. Adequate incisions were taken, tibia was exposed proximal and distal to the fracture site, fracture reduction was achieved by indirect reduction techniques with the help of pointed reduction forceps and calcaneal traction in few cases.

A tunnel was made sub-muscularly with the help of Cobb's elevator. The plate was passed through this tunnel with the help of thread tied to one end and pulled with the help of a rongeur and fixed with screws on either side under fluoroscopic guidance, each fragment was fixed on either side with a purchase of minimum six cortices. Wound was closed in layers. All the patients received single dose antibiotics preoperatively and postoperatively for 24 hours.

All patients were given posterior above knee backslab, which was removed on the second postoperative day. Static quadriceps exercises and knee and ankle range of movements exercises were started on postop day 1. Non-weight bearing ambulation was started on the second postoperative day. Sutures were removed on postop day 12. Partial weight bearing ambulation was started from 6 weeks and full weight bearing after 12 weeks when sufficient callus was seen on radiograph.

On an average, all the patients were able to bear full weight on the operated limb from 12 weeks onwards, except for one case with delayed union which ultimately united at 22 weeks after augmenting with bone graft following which, full weight bearing was allowed.

Delta External Fixator Group: Open fractures were treated by thorough irrigation, wound debridement, and appropriate intravenous antibiotics. After stabilizing the fracture, based on condition of the soft tissue, the wounds were left open or were approximated without tension to cover most of the exposed bone. Closed fractures were treated with reduction and application of a backslab, followed by operative treatment within 72 hours, unless severe swelling or skin blisters were present or there were medical contraindications. If the operation was delayed for more than 48 hours, the affected limb was elevated on a Bohler-Braun frame. The average time from the injury to the operative fixation of the closed fractures was around 5 days. The indications for an operation included an open fracture and unacceptable alignment of the fracture (>100 in any plane) of the tibia or the fibula. Preoperatively and postoperatively, antibiotics were administered parenterally to all the patients.

Surgical Procedure: All patients had limited internal fixation combined with external fixation. AO fixator was used for external fixation of tibia in 13 patients. For external fixation, three proximal and two distal 4.5mm schanz pins were used. Distal fixation was achieved using two schanz pins in the distal fragment using a T-clamp and a calcaneal pin. No tibia was fixed with a plate. Bone grafting was not done at the time of the initial fixation in any patient. Reduction of the fracture was performed by closed manipulation with traction or through a small (<2cm length) antero-medial incisions.

Results

In our study, 11.5% of the patients were below 30 years of age, 23.1% were between the ages of 31 to 40, 23.1% between the ages of 51 to 60.

20 % of the total patients were females and 80 % were males. Mode of injury was Road Traffic Accident (RTA) in 76.9% of the cases and fall in 23.1% cases. About 92.3% of the patients had an associated fibula fracture.

Right sided fracture predominated with 65.4% compared to left side with 34.6%. 22 patients had open type of injury, while 8 were of closed type. 30.8% fractures were of 43C2 type. 17 patients underwent Delta External fixator application and 13 patients underwent internal fixation by MIPO technique. The mean time to weight bearing in Delta external fixator group was 8.92 weeks versus 10.46 weeks in the MIPO group. The mean time of radiological union in Delta external fixator group was 18.08 weeks and 20.23 weeks in MIPO group.

The mean AOFAS score at 1 year follow up period was 76.69 in Delta External fixator group and 81.15 in MIPO group. We encountered 3 cases of superficial infection in Delta External fixator group, 2 of the cases had Checketts and Otterburn grade 2 type of infection which was controlled by local pin site care and oral antibiotics and 1 patient had grade 1 infection which was controlled just by local pin site care. Whereas 2 cases in MIPO group developed deep infection leading to wound dehiscence and needing repeated wound debridement and higher intravenous antibiotics.

Table 1: Age distribution of study cases

Study	Our study	Richards et al [8]	Davidovitch et al [12]	Cheng Wang et al [9]
Ex fix	51.07	40.6	43	37.2
MIPO	48.15	46.9	39	40.1

Table 2: Sex distribution of study cases

Study	Our study	Richards et al [8]	Davidovitch et al [12]	Cheng Wang et al [9]
Male %	80	Not reported	63.1	91
Female %	20	Not reported	36.9	9

Table 3: Mechanism of injury

Study	Our study	Richards et al [8]	Davidovitch et al [12]	Cheng Wang et al [9]
RTA %	73.3	56	41.3	69.6
Fall %	26.6	44	41.3	30.4

Table 4: Time from trauma to complete weight bearing

Study	Our study	Luis N Cisneros et al [11]
Ex fix	8.92 weeks	10 weeks
MIPO	10.46 weeks	8.2 weeks

Table 5: Time from trauma to radiological union

Study	Ex fix	MIPO
Our study	18.08 weeks	20.23 weeks
Davidovitch et a12	22 weeks	20.8 weeks
Cheng Wang et al9	26.2 weeks	25.3 weeks
Stacy Bacon et al10	24.5 weeks	39.1 weeks
Luis N Cisneros et al11	19.1 weeks	21.23 weeks

Table 6: Functional outcome according to AOFAS score

Study		AOFAS		P value
		Mean	SD	
Our study	Ex fix	76.69	7.79	0.116
	MIPO	81.15	6.01	
Davidovitch et al [12]	Ex fix	77.1	14.4	0.48
	MIPO	72.4	21.0	
Luis N Cisneros et al [11]	Ex fix	77.33	16.1	0.64
	MIPO	84.4	11.23	

MIPO Group:

Figure 1: PRE-OP XRAYS

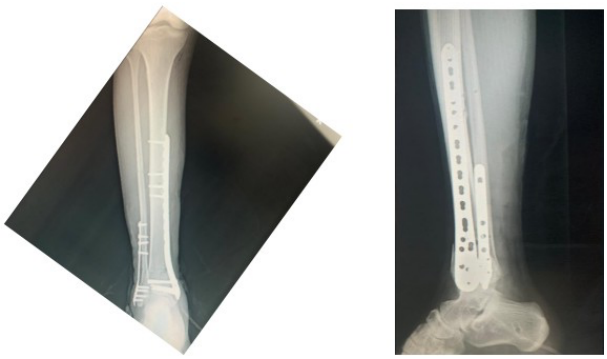

Figure 2: IMMEDIATE POST OP X RAYS

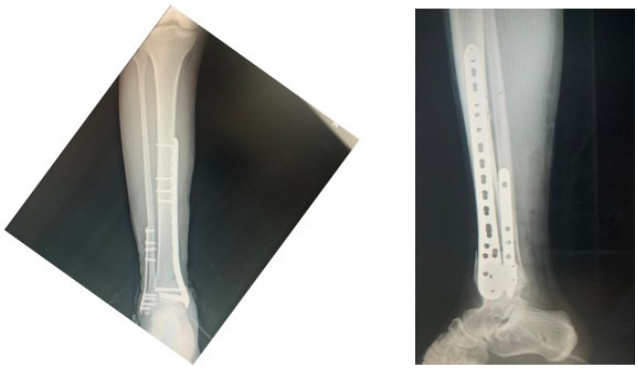

Figure 3: 1 YEAR FOLLOW UP X RAYS

Figure 4: ROM AT I YEAR FOLLOW UP

Delta External Fixator Group:

Figure 5: PRE-OP XRAYS

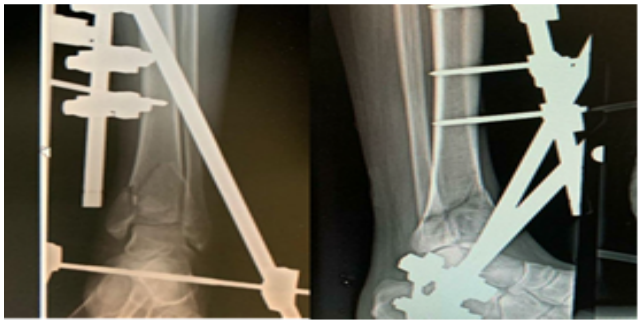

Figure 6: IMMEDIATE POST OP XRAYS

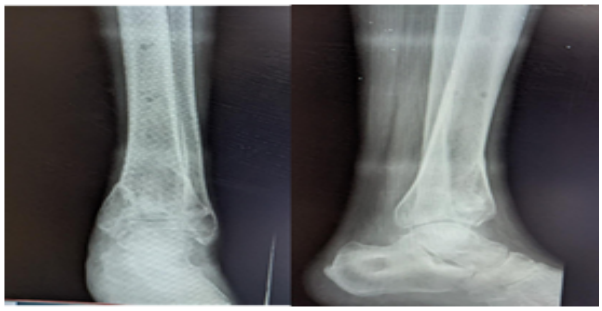

Figure 7: 1 YEAR FOLLOW UP XRAYS

Figure 8: ROM AT 1 YEAR

Discussion

The goal of operative treatment in Tibial Pilon fractures is to align the articular surface anatomically, while still providing enough stability to allow early motion of the ankle joint. This should be done using approaches that minimize osseous and soft tissue devascularization. Because of the development of minimally invasive surgery, Percutaneous plating has challenged interlocking nailing, as locked plate designs act as fixed angle devices which is thought to preserve the periosteal blood supply around the fracture site.

In our study, the age of the patients ranged from 22years to 68years with the mean age of 49.6years (SD14.7), 24 males (80%) and 6(20%) females involved. 22 cases (73.3%) were due to RTA and 8 cases (26.6%) were due to self-fall. This is expected in developing countries with a large population where males are predominantly the breadwinners for their families and high rate of RTAs could be explained by poor road conditions and non-adherence to the road traffic rules. The Delta External Fixator group has slightly earlier weight bearing at 8.92 weeks compared to MIPO group (10.46 weeks) since the latter is an invasive surgery and plate is a non-weight bearing implant in contrast to Delta External fixator which is a partially weight bearing implant.

In our study, we found that the union time in our Delta External fixator group was slightly earlier (18.08 weeks) than the MIPO group (20.23 weeks). This was comparable to the study by Stacy Bacon et al [10] and Luis N Cisneros et al [11] which showed faster union time at 24.5 weeks (External fixator group) versus 39.1 weeks (ORIF group) and 19.1 weeks (Delta External Fixator group) versus 21.23 weeks (ORIF group) respectively. Thus, Delta External fixator being a noninvasive surgery, helps early fracture healing and weight bearing by preserving the blood supply of the distal tibia.

In our study, the mean AOFAS score at 1 year in the Delta External fixator group was 76.69 versus 81.15 in the MIPO group. The difference in the functional outcome between both the groups was found to be statistically insignificant. This was comparable to the study by Davidowitch et al [12]

where the AOFAS score at 1year was 77.1 in the Delta External Fixator group and 72.4 in ORIF group, with a P value of 0.48 and the difference being statistically insignificant. The difference in range of motion values between both the groups at 1 year follow up was statistically insignificant, with mean ankle dorsiflexion of 11.92 in Delta External fixator group and 12.69 in MIPO group. Mean plantar flexion value was 36.92 for Delta External fixator group and 37.69 for MIPO group. In our study, we encountered 2 cases of deep infection and wound dehiscence in MIPO group and in the Delta External fixator group, 3 cases developed superficial infections. Luis N Cisneros et al [11] in their study found 6(46.15%) patients treated by hybrid ex fix had superficial infection compared to 3 (16.7%) patients in ORIF group. Whereas, there was 1 (7.7%) patient treated with hybrid ex fix getting deep infection and 3 (16.7%) patients treated with ORIF getting deep infection. Although neither of these were statistically significant.

Conclusion

The ideal surgical management of tibial pilon fractures remains to be a grey zone in the field of Orthopaedics. In our study, we found a few key differences between the two treatment modalities, MIPO and Delta External fixator, that might help us decide between the two. MIPO group, being the more invasive of the two, saw more instances of deep infection potentially leading to more patient morbidity and financial burden. Delta external fixator group on the other hand despite having slightly lower AOFAS score, saw no instances of deep infection and had earlier weight bearing and earlier union times, and reduced morbidity especially in the frail and patients with comorbidities.

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