



## SURGICAL TREATMENT OF PILON FRACTURES BY DELTA-EXTERNAL FIXATOR VERSUS MIPPO – A CLINICAL STUDY

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**ABSTRACT** **BACKGROUND :** The treatment of Pilon fractures are among the most dreaded of all ankle joint fractures, and they continue to pose a challenge to the trauma surgeon. They are associated with substantial soft tissue damage, articular surface disturbance, and osseous comminution. The optimal management of pilon fractures and the ideal treatment for these fractures are still debatable.

**Aim:** The aim of this study was to analyze the functional outcome of patients with Pilon fractures treated by Delta External Fixator versus MIPPO.

**Results:** Among the 26 patients (19 male and 7 female), included in the study, followed for a minimum period of 6 months, outcome was excellent in the Delta External fixator group than in ORIF group. Although the final AOFAS score and ROM was slightly less in Delta External fixator group, the time to weight bearing and time to radiological union were slightly shorter in Delta External fixator group than ORIF group in our study.

### KEYWORDS :

#### INTRODUCTION

Pilon fractures are among the most serious ankle joint fractures, and they continue to pose a challenge to the orthopaedic surgeon. They are associated with substantial soft tissue damage, articular surface disturbance and osseous comminution and are frequently induced by forceful trauma.<sup>1</sup>

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 as a result of an axially directed stress.<sup>2</sup> 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 from the joint line.<sup>3</sup>

Pilon fractures account for 7% of all tibial fractures and 1% to 10% of all lower limb fractures. The fibula is fractured in 85 percent of high-energy tibial pilon fractures.<sup>4</sup> 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 prevalent, and even when there isn't an open lesion, closed traumas can cause severe soft tissue injury.<sup>5</sup>

In the treatment of distal tibial fractures, the main goal is to achieve proper alignment, length, and rotation in order to achieve a stable union and functionally useable limb. The literature describes a variety of surgical and nonsurgical treatment approaches.

However, because the range of tibia injuries is so wide, no single treatment strategy is appropriate for all fractures.<sup>6</sup> There is currently no level I evidence for optimum management using both internal and external fixation procedures, either alone or in combination.<sup>6</sup> The severity of the soft tissue injury, the fracture pattern, and the treating surgeon's experience all influence treatment options.<sup>7</sup>

#### MATERIALS AND METHODS

A prospective study carried out at the Department of Orthopaedics, KIMS Hubli, Karnataka. Twenty six patients were studied. They were followed up for a period of 1 year. The patients consisted of 19 males and 7 females whose age-group ranged from 30 years to 75 years. Right tibia was involved in 17 cases and left tibia in nine patients. Modes of injury were road traffic accident in 20 patients and self-fall in 6 patients. The fractures were classified using AO classification system.

Open fractures were classified with Gustilo-Anderson classification and soft tissue condition on presentation was classified using Oestern and Tscherné 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 more than 18 years both males and females.
- AO Classification-Distal Tibial intra-articular fractures
- Patient medically fit for surgery
- Consent to participate in the study

#### Exclusion Criteria:

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

#### Orif Group (Plating) - Mippo Technique

After written informed consent, the patients were operated under spinal anaesthesia. A Pneumatic tourniquet was applied in the upper thigh. 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. 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 patients received single dose antibiotics preoperatively and post-operatively for 24 hours. All patients were given posterior above knee splint which was removed on the second post-operative day. Static quadriceps exercises and knee and ankle range of movement exercises were started the day following surgery. Non-weight bearing ambulation was started on the second post-operative day. Sutures were removed on the 12th postoperative day. Partial weight bearing ambulation was started from six 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 bone grafting following which full weight bearing was allowed.

#### Delta External Fixator Group

An open fracture was treated by irrigation, thorough debridement, and appropriate intravenous antibiotics. After repairing the fractures, the wounds were left open or were approximated loosely to cover most of

the exposed bone, according to the condition of soft tissue. Closed fractures were treated with reduction and application of a splint, followed by operative treatment within seventy-two hours unless severe swelling or fracture blisters were present or there were medical contraindications. If the operation was delayed for more than forty-eight 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 five days. The indications for an operation included an open fracture and unacceptable alignment of the fracture (greater than 10 degrees in any plane) of the tibia or the fibula. Preoperatively and postoperatively, antibiotics were administered parenterally to all 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 4.5-millimeter half-pins were used. Distal fixation was accomplished with use of two half-pins in the distal fragment using a T-clamp including 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 (less than two-centimeter-long) antero-medial incision in each patient.

**RESULTS**

In our study, 11.5% of the patients were below 30 years of age, 23.1% were between the age of 31 to 40, 23.1% between the age of 51 to 60. 26.9 % were females and 73.1 % males. Mode of injury was 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 more with 65.4% compared to left sided with 34.6%. 18 patients had open type of injury and 8 were closed type. 30.8% fractures were belongs to 43C2 type.

13 patients underwent Delta-fix application and 13 patients underwent internal fixation by MIPPO. The mean time to weight bearing in ex fix group is 8.92 weeks versus 10.46 weeks in MIPPO group. The mean time of radiological union in Delta-fix group was 18.08 weeks and 20.23 weeks in MIPPO group. The mean AOFAS score at 1 year follow up in Delta External fixator group was 76.69 and 81.15 in ORIF 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 ORIF group encountered deep infection leading to wound dehiscence and needing repeated wound debridement and higher IV antibiotics to tackle the infection.

**DISCUSSION:**

The goal of operative treatment in Pilon fractures is to align the joint surface anatomically while still providing enough stability to allow early motion. This should be done using approaches that minimise osseous and soft tissue devascularization. Because of the development of minimally invasive surgery, Percutaneous plating has challenged interlocking nailing as locked plate designs and 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 22yrs to 68yrs with the mean age of 49.6yrs (SD14.7), 19 males (73.1%) and 7(26.9%) females involved where 20 cases (76.9%) were due to RTA and 6 cases (23.1%) were due to slip and 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 bad road conditions and non adherence to road traffic rules.

The Delta External Fixator group has slightly earlier weight bearing at 8.92 weeks compared to MIPPO group (10.46 weeks) since the latter in 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 MIPPO group (20.23 weeks). This was comparable to the study by Stacy Bacon et al<sup>10</sup> and Luis N Cisneros et al<sup>11</sup> which showed faster union time at 24.5 weeks (Delta-Fix group) versus 39.1 weeks (ORIF group) and 19.1 weeks (Delta Extern Fixator group) versus 21.23 weeks (ORIF group) respectively. Thus Delta External fixator being non invasive surgery

helps early fracture healing and weight bearing due intact blood supply to 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 ORIF group was 81.15. The minor difference in the functional outcome between both the groups was found to be statistical insignificant. This was comparable to the study by Davidovitch et al<sup>12</sup> where the AOFAS 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 yr follow up was statistically insignificant, with mean ankle dorsiflexion of 11.92 in Delta External fixator and 12.69 in ORIF group. And mean plantarflexion value of 36.92 for Delta External fixator group and 37.69 for ORIF group.

In our study we encountered 2 cases of deep infection and wound dehiscence in ORIF group and in the Delta External fixator group we saw 3 cases get superficial infections. Luis N Cisneros et al<sup>11</sup> in their study found the 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 exfix 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 plafond fractures remain to be a grey zone in the field of Orthopaedics. In our study we found a few key differences between the two treatment modalities, MIPPO and Delta-Fix, that might help us decide between the two. MIPPO group, being the more invasive of the two, saw more instances of deep infection potentially leading to more patient morbidity and financial burden. Delta-fix 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 reduces morbidity especially in the frail and patients with comorbidities.

**CONFLICT OF INTEREST**

The author does not declare any conflict of interest.

**TABLES**

**Table 1 – Age distribution of study cases**

Study	Our study	Richards et al <sup>8</sup>	Davidovitch et al <sup>12</sup>	Cheng Wang et al <sup>9</sup>
Ex fix	51.07	40.6	43	37.2
ORIF	48.15	46.9	39	40.1

**Table 2 - Sex distribution of study cases**

Study	Our study	Richards et al <sup>8</sup>	Davidovitch et al <sup>12</sup>	Cheng Wang et al <sup>9</sup>
Male %	73.1	Not reported	63.1	91
Female %	26.9	Not reported	36.9	9

**Table 3 - Mechanism of injury**

Study	Our study	Richards et al <sup>8</sup>	Davidovitch et al <sup>12</sup>	Cheng Wang et al <sup>9</sup>
RTA %	76.9	56	41.3	69.6
Fall %	23.1	44	41.3	30.4

**Table 4 - Time from trauma to complete weight bearing**

Study	Our study	Luis N Cisneros et al <sup>11</sup>
Ex fix	8.92 weeks	1.0 weeks
ORIF	10.46 weeks	8.2 weeks

**Table 5 – Time from trauma to radiological union.**

Study	Ex fix	ORIF
Our study	18.08 weeks	20.23 weeks
Davidovitch et al <sup>12</sup>	22 weeks	20.8 weeks
Cheng Wang et al <sup>9</sup>	26.2 weeks	25.3 weeks
Stacy Bacon et al <sup>10</sup>	24.5 weeks	39.1 weeks
Luis N Cisneros et al <sup>11</sup>	19.1 weeks	21.23 weeks

**Table 6 – Functional outcome according to AOFAS score**

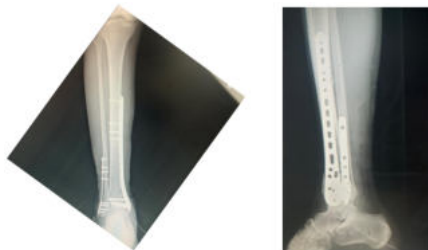
Study		AOFAS		P value
		Mean	SD	
Our study	Ex fix	76.69	7.79	0.116
	ORIF	81.15	6.01	
Davidovitch et al <sup>12</sup>	Ex fix	77.1	14.4	0.48

	ORIF	72.4	21.0	
Luis N Cisneros et al <sup>11</sup>	Ex fix	77.33	16.1	0.64
	ORIF	84.4	11.23	

**Mippo Group – Pt 1**



**Pre Op X Rays**



**Immediate Post Op X Rays**



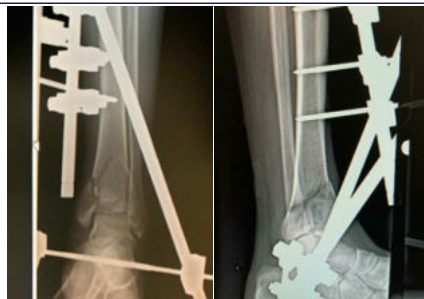
**1 Year Follow Up X Rays**



**Rom At 1 Year**



**Delta-fix Group – Pt 3**



**Pre Op X Rays**



**1 Year Follow Up X Rays**



**Rom At 1 Year**

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