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## Internal fixation of low energy pilon fractures: Prospective study of two treatment options (ORIF/MIPO)

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### Abstract

**Objective:** Pilon fractures are intra articular distal tibia fractures involving articular surface or tibial plafond. Various options of treatments are open reduction and internal fixation (ORIF), external fixation, arthroscopic assisted fixation, minimally invasive plate osteosynthes (MIPO). MIPO is an option for extra articular and few undisplaced type B fractures. It may not be suitable in complete articular fractures (43 C) type injuries unless severe soft tissue injury is involved. Type C fractures need accurate articular reduction which may need open reduction and internal fixation. This is a prospective study comparing functional outcome and complications of internal fixation of different types of low energy pilon fractures treated in our hospital with MIPO and ORIF technique.

**Methods:** This prospective study was conducted in our trauma centre from 2012 to 2015 on pilon fractures. We included all low energy pilon fractures (OTA A, B, and C) both open and closed fractures treated by internal fixation with MIPO or ORIF. Group 1 subjects were treated by distal tibia locking plates by MIPO technique. Group 2 by open reduction and internal fixation by different approaches as required depending on fracture fragments. AOFAS ankle hind foot scale was used to assess outcome and was done at the end of follow-up.

**Results:** Pilon fractures type A and B were mainly treated by MIPO while type C was mainly treated by ORIF. Delayed union more frequently seen in MIPO and flap necrosis and delayed wound healing in ORIF group. There was no significant difference in functional outcome by the end of two year as shown by AOFAS scoring (p value 0.851).

**Conclusion:** Internal fixation is an effective method of treatment for pilon fractures. MIPO and ORIF are equally effective provided articular congruity is maintained.

**Keywords:** Pilon fracture, MIPO, AOFAS, ORIF

### 1. Introduction

Pilon fractures are intra articular distal tibia fractures involving articular surface or tibial plafond. They make 1% of lower limb fractures and 7% of tibia fractures [1]. This fracture is caused by high or low energy trauma. It is associated with articular cartilage damage metaphyseal comminution and soft tissue injuries which make the management challenging to orthopaedic surgeons. Rotational injuries are low energy patterns with less soft tissue and articular involvement [2]. There are various options of treatment like open reduction and internal fixation (ORIF), external fixation, arthroscopic assisted fixation, minimally invasive plate osteosynthes (MIPO). Treatment options must concentrate both on fracture as well as soft tissue. The important objectives of surgical management are congruous articular surface and solid bony union with minimal damage to soft tissues. Conservative management is impractical as it is associated with malunion, nonunion, stiffness and secondary arthritis [3]. The important classification systems used are Reudi Algower and OTA classification based on radiographic criteria's [4, 5]. The OTA classification divided pilon fracture into 43 A (extra articular) 43 B (partial articular) 43 C (complete articular fractures). MIPO is an option for extra articular and few undisplaced type B and C fractures. It may not be suitable in complete articular fractures (43 C) type injuries unless severe soft tissue injury is involved. Type C fractures need accurate articular reduction which may need open reduction and internal fixation. Primary internal fixation of these fractures results in soft tissue damage wound

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dehiscence and delayed union [6]. External fixators can be an alternative however it may result in pin tract infection, malunion and ankle stiffness [7]. Pilon fractures behave different clinically based on type of fracture. The treatment methods vary depending on fracture types, treating centre and experiences of surgeons. This is a prospective study comparing functional outcome and complications of different types of low energy pilon fractures (OTA Classification) treated in our hospital treated by MIPO and ORIF.

## 2. Materials and Methods

This study was conducted in our trauma centre from 2012 to 2015 which is a tertiary centre dealing with common orthopaedic injuries. We included pilon fractures (OTA A, B, and C) both open and closed fractures treated by surgical fixation with MIPO or ORIF. Fractures classified either open or closed according to Gustilo Andersons [8]. Cases treated exclusively or partially by external fixators were excluded from study. Patients with severe head injury, fractures around knee and foot, severe soft tissue injury (Tscherne type 3) and compartment syndrome were also not included in this group.

Age, gender, mechanism of trauma, side, co morbidities and soft tissue status were noted. Patients divided into two groups based on treatment methods for pilon fractures. Group 1 consisted of mainly OTA A and B fractures while group 2 included OTA B and C fractures. Group 1 subjects were treated by distal tibia locking plates by MIPO technique. Group 2 by open reduction and internal fixation by different approaches as required depending on fracture fragments. In both group of patients associated fibular fractures were treated by open reduction method with tubular plates. Distal tibia locking plates, anterolateral L shaped plates, distal radius T plates, and 4 mm cannulated cancellous screws were used for type B and C fractures as required to achieve perfect articular congruity.

Group 1 consisted of mainly OTA A and B and few C1 fractures while group 2 included OTA B and C fractures. Anteromedial approach was used for cases treated by MIPO technique. Surgical approach was decided by fracture characteristics and reduction [9]. Postero medial, anterolateral

or both for internal fixation in group 2 subjects. Posterior fragments could be managed with postero medial approaches. Cases with associated fibular fractures were treated by ORIF with 1/3 tubular plates in both group of patients. Unstable fibula was fixed first to stabilize lateral column in both groups. Anterolateral incision was used for fibula and anterolateral tibia fracture fragments in type B and C cases. Distal tibia locking plates, anterolateral L shaped plates, distal radius T plates, and 4 mm cannulated cancellous screws were used for type B and C fractures as required to achieve perfect articular congruity.

CT scanning with 3D reconstruction was obtained in addition to plain x rays for type B and C fractures to assess the fracture pattern and articular discontinuity. Surgical planning was done with 3D CT. We delayed surgery until severe swelling reduced and fracture blisters healed. All cases were operated within 10 to 12 days. Open fractures underwent wound debridement and surgical fixation in the same sitting. Closed reduction was tried in all cases, put on below knee slab and limb was elevated. Standard protocols were followed for antibiotic use. Surgeries were done by senior surgeons. Bone grafting was done in three cases with metaphyseal comminution and bone loss in group 2 patients. Bone graft was obtained from iliac crest. Post operatively cases were followed by 2, 4 and 6 week and then at 3, 6 and 12<sup>th</sup> month. Patients were assessed for wound healing and fracture union. X-rays were taken during follow up visits for assessing bridging callus formation and identify any signs of nonunion like increased gap and sclerotic changes of fracture ends. Partial weight bearing was started by 4 to 6 weeks while full weight bearing once fracture unites. Cases with delay in wound healing were regularly monitored and plastic surgery assistance was taken when required. Physiotherapy help was taken for improving range of ankle movements.

AOFAS ankle hind foot scale was used to assess outcome and was done at the end of follow-up. It has got three components: pain, function, and alignment with scores 40, 50 and 10 respectively [10]. X-rays of two type C3 pilon fractures treated by open reduction and internal fixation shown in figure 1a, b, c and 2a, b, c.



**Fig 1a:** X ray of a 32-year-old patient with complete articular pilon fracture (C3) right side. 1b. Post op x-ray of the same patient. 1c. X ray at two year follows up. Fracture has well united with minimal arthritic changes



**Fig 2a:** X-ray of 40-year-old patient with complete articular pilon fracture (C 3) left side. 2b. Post op x ray of the same patient. 3c. X ray at two year follow up.

**2.2 Statistical analysis**

Data was entered in Microsoft excel (Windows 7; version 2007) and analysis were done in statistical package for social science (SPSS) version 16.0 for windows software. Level of significance was set as .05. Man Whitney U test was used for calculating level of significance of difference between AOFAS scoring among two groups. Descriptive analysis using cross table was used to find out fracture types and different associated complications.

**3. Result**

We studied 18 patients in group 1 and 16 in group 2. Road traffic accident was the commonest reason for injury in group 2 while fall from height in group 1. Age wise statistics revealed more of elderly patients in group 1. MIPO group contained majority of Type A fractures (50%) while ORIF

group type C fractures (75%). There were two type 2 open fracture in group 1 and 2 respectively and one type 3 in group 2. All open fractures united but delayed union seen in two cases. One type 3 fracture needed secondary flap coverage. Delayed union was relatively common in group 1 while delayed wound healing and flap necrosis in group 2. There were no cases of non-union documented. Patient and fracture details are shown in table 1.

AOFAS scoring done at the end of two year follow up and compared among two groups. Three components (pain, function, alignment) and total scoring compared using Man Whitney U test to find out the level of significance (Table 2). Mean AOFAS scoring was 78.9 and 77.12 for group 1 and 2 respectively. P value showed no significant difference between two treatment groups. Average union time was 18.6 weeks (ranging from 12 to 28 weeks).

**Table 1:** Patient profile of pilon fractures

	MIPO	ORIF
Gender		
Male: female	10:8	12:4
Age	47.6 (SD=16.8)	48.3 (SD=14.9)
Fracture (close: open)	14:4	13:3
Open fracture (4:3) Type 1: type 2: type 3	2:2:0	0:2:1
Mode of injury RTA: FFH	8:10	9:7
Fracture classification (OTA)		
A1: A2: A3	1:2:6	0:0:0
B1: B2: B3	3:1:2	0:2:2
C1:C2:C3	3:0:0	2:4:6
Complications:		
Delayed wound healing	2	4
Delayed union	3	1
flap necrosis	0	2

MIPO=Minimal invasive plate osteosynthes, ORIF=Open reduction and internal fixation, RTA = Road traffic accident, FFH=Fall from height, SD= standard deviation

**Table 2:** AOFAS and its different components between two groups.

	group	N	Mean Rank	Sum of Ranks	p value
pain	1	18	18.44	332.00	.523
	2	16	16.44	263.00	
	Total	34			
function	1	18	18.83	339.00	
	2	16	16.00	256.00	.385
	Total	34			
AOFAS	1	18	18.44	332.00	.555
	2	16	16.44	263.00	
	Total	34			
alignment	1	18	17.33	312.00	.898
	2	16	17.69	283.00	
	Total	34			

#### 4 Discussion

This prospective study was conducted to compare the results of different types of pilon fractures treated surgically. We had 18 patients in group 1 and 16 in group 2. AOFAS ankle and hind foot grading score was used for functional assessment at the end of rehabilitation after complete fracture union. Complications like nonunion, wound necrosis, delayed wound healing were compared between two groups. MIPO was used for type A and few type B and C fractures while majority of type C cases were treated by ORIF. All associated fibular fractures were treated by open reduction and MIPO was applied only with respect to tibia fixation. There were 16 patients with associated fibular fracture in group 1 and all patients in group 2. Majority of patients were males. Fall from height and road traffic accidents were two major causes of these injuries.

A cohort study on primary fixation of type C pilon fractures came out with interesting finding that majority of patients treated primarily with ORIF showed good results. They performed ORIF in 88% cases within 48 hours and proved that type C pilon fractures may be treated with early fixation with relatively low complications. Our study similar to this article revealed that internal fixation of type C fracture yields good results comparable to other types of pilon fractures<sup>[11]</sup>.

Milenkovic *et al.* in their retrospective study evaluated the efficiency of external fixators and minimal internal fixation for type B and C fractures. The AOFAS scoring revealed 51.6% excellent and 32.25% good results respectively<sup>[12]</sup>.

A retrospective study on long term results of internal fixation of pilon fractures reported with 15% excellent and 45% good results. Cutaneous and deep infection, skin necrosis, severe arthritis was the complications seen in their series of cases. They hailed AO system of classification as most objective and useful and opined internal fixation to be used for specific fracture types<sup>[13]</sup>. We too came across few complications like skin necrosis and delayed wound healing. We took the help of plastic surgeons in two cases and wounds healed well. These cases fared well and AOFAS showed comparable scores.

Complications and sequelae of internal fixation of pilon fracture were studied on a large group of patients. Rate of infection was 8.7% and flap necrosis was 15.2%. AOFAS yielded 30.5% excellent 46.7% good results. Open fractures were commonly associated with nonunion and flap coverage. Infection and suboptimal reduction caused more of complications in these patients<sup>[14]</sup>. This study is similar to our study but with a greater number of subjects and 3.3 years of follow up. We saw 25% delayed wound healing and 12% flap necrosis in our ORIF group of cases. MIPO group showed 11% delayed wound healing and no flap necrosis. Non union was not reported probably because we did primary bone grafting and there were less number of open fractures. We too observed more number of skin necrosis over medial incision site because of subcutaneous site and minimal soft tissue reserve.

A retrospective study on comparison of primary open reduction and internal fixation versus two staged procedure concluded that no significant difference found in clinical, radiological and functional outcomes except for prolonged hospital stay. They recommended one stage procedure for Type C fractures and Tscherne 1, 2 fractures<sup>[15]</sup>. We performed surgeries on our patients within 10 to 12 days.

Carlo Biz *et al.* in their retrospective study compared medium to long term clinical and radiographic outcomes of three different (MIPO, ORIF and EF) treatment types. They came out with comparable results between MIPO and ORIF with

AOFAS scores 82.41 and 79.83 respectively. There was a statistically different outcome between internal and external fixations<sup>[16]</sup>. We got consistent and statistically comparable outcome with MIPO and ORIF methods.

There are some limitations in our study. We excluded cases with severe soft tissue and vascular injury which would definitely require external fixators. Secondary osteoarthritis needs longer duration of follow up. Studies with a greater number of cases and follow up durations are required to assess secondary osteoarthritis with type B and C pilon fractures.

#### 5. Conclusion

Internal fixation is an effective method of treatment for pilon fractures. MIPO and ORIF are equally effective provided articular congruity is maintained.

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