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Treatment of closed tibial pilon fracture using Open reduction internal fixation (ORIF) versus External fixation with combined limited internal fixation (LIFEF).

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ABSTRACT
Background:*Tibial pilon fracture is a comminuted fracture of distal tibia.The optimum treatment of this fracture remains controversial, some advocate the use of Open reduction internal fixation (ORIF) to avoid articular incongruence and consequent posttraumatic arthritis and to maximise long term results. Others advocate the use of External fixation with combined limited internal fixation (LIFEF) in these fractures to reduce the soft tissue related complications and blood loss. The purpose of this study is to throw light on the ongoing controversies about the choice of treatment modality.*
Material and Methods: *A prospective randomized study was done on 20 patients treated for closed tibial pilon fracture with Open reduction internal fixation (ORIF) and External fixation with combined limited internal fixation(LIFEF).*
Results: *Both the procedure open reduction internal fixation and external fixation with combined limited internal fixation contribute towards optimal reduction and good stabilization in plafond fracture.*
Conclusions: *There is no significant difference in union rate while comparing both the groups procedure open reduction internal fixation and external fixation with combined limited internal fixation. Statistically significant differences were found in group of cases with external fixation with combined limited internal fixation in regards to the less blood loss, less operative time and early partial weight bearing.*
Keywords: *pilon fracture, comminuted, soft tissue, fixation.*

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I. Introduction

Tibial pilon fracture is a comminuted fracture of distal tibia, By convention all fractures of the tibia involving the distal articular surface should be classified as tibial pilon fractures, except for medial or lateral malleolar fractures and trimalleolar fractures where the posterior malleolar fracture involve less than 1/3 of articular surface[1]. Incidence of tibial pilon fracture is <1% of lower extremity fractures and 5-7% of all tibial fractures[2].

These fractures are often multi-fragmentary and there is the possibility of anterior, central or posterior subluxation[3]. They are usually high energy injuries with axial compression, that is the talus impacted into the tibial plafond following road traffic collision and fall from height, but they can also occur less frequently by low energy torsional mechanism of injury[4]. The choice of treatment must take into account not only the stabilization of the fracture, but also the management of the soft tissue injury which is frequent cause of subsequent complications[5]. The optimum treatment of this fracture remains controversial, some advocate the use of Open reduction internal fixation (ORIF) to avoid articular incongruence and consequent posttraumatic arthritis and to maximise long term results. Others advocate the use of External fixation with combined limited internal fixation (LIFEF) in these fractures to reduce the soft tissue related complications and blood loss.

we undertook the single blinded randomized control trial with closed tibial pilon fracture who were treated with either open reduction and internal fixation or external fixation with combined limited internal fixation.

The purpose of this study is to throw light on the ongoing controversies about the choice of treatment modality, choice of implant and surgical approaches with the aim of increasing the functional outcome, reducing the danger of skin complications like infection, sloughing and necrosis and ultimately giving the patient with least complications post operatively.

II. Material And Methods

We conducted a prospective study for 20 cases of tibial plafond fractures aged between 18yrs - 65yrs attending the OPD and Emergency department of 'Orthopaedics, Gauhati Medical College & Hospital, Guwahati who met the inclusion criteria outlined below with effect from 1st April 2021 to 30th September 2022.
Study Design: prospective comparative study
Study location: Department of 'Orthopaedics, Gauhati Medical College & Hospital, Guwahati
Study Duration: 1st April 2021 to 30th September 2022.
Sample Size: 80 patients.

INCLUSION CRITERIA
Only those patients who give written and informed consent will be included in the study
- All tibial-plafond fractures in patients aged 18-65yrs.
- Closed tibial plafond fracture.
- Duration of injury < 2 weeks
- Competent neurological and vascular status of the affected limb.
- Ipsilateral hip, knee, and contralateral lower limb functionally good enough, so as not to exert a serious adverse effect on the rehabilitation process.
- Only patients with a near normal daily activities of life
- Patients who meet the medical standards for routine elective surgery.

EXCLUSION CRITERIA
- Patients who do not give consent.
- Patients age <18 years and >65 years.
- Inability to take part in post operative rehabilitation.
- Medical contraindications to surgery
- Previous tibial abnormalities (infection, tumour)
- Patients with multiple major bone fractures
- Duration of injury > 2 weeks
- Associated ipsilateral or contralateral major limb injury affecting treatment or rehabilitation protocol.
- Doubtful neurovascular status of the limb.

Procedure methodology

All the patients in this study were admitted either through out-patient department or through emergency department of the college. On receiving the patient, initial symptomatic treatment and a detailed history of the patient in regard to age, sex, socio-economic background, duration & mode of injury, previous illness or treatment, was taken as per the proforma.

A thorough clinical examination was carried out to exclude any associated injury & other medical and surgical illness like head injury which may require necessary treatment. Injured limb examined thoroughly for open fractures, distal neurovascular status and to exclude compartment syndrome. Initial radiographs were then ordered taking true antero-posterior, lateral, mortise, along with centered orthogonal views of the joint above and below of the ankle. For grossly deformed ankle provisional closed reduction was done before applying the slab. Radiographs were examined for number of fragments, articular and metaphyseal comminution and displacements.

At this stage, randomization was done using the plan generated from the website www.randomization.com (seed no. - 11186) to allocate the patient into one of the following two treatment models.

Group A- Open reduction and internal fixation
Group B- External fixation with combined limited internal fixation

Open reduction and internal fixation
Approaches:
1. Anteriolateral approach
2. Anteriomedial approach
3. Posteriomedial approach

Reduction and fixation
•After proper dissection the fracture fragments are identified, fracture fragments reduced and held with help of a k-wire. Reduction confirmed with IITV. Plate was placed above the epiperiosteal surface from the antero-medial

aspect of the tibia when done through anteromedial approach, posterior aspect in posteriomedial approach and in anterolateral aspect of the tibia when done through anterolateral aspect.

•First the plate is adjusted to the periarticular part of the tibia. It is important that the plate is in the correct position in relation to the joint space and an intraarticular K-wire can be used as a guide under image intensifier control.

•The first 3.5 mm cortex screw is inserted in one of the most distal plate holes just above the ankle joint thus approximating the plate to the bone. This is crucial for preventing irritation of the thin soft-tissue cover at that level. This cortex screw should not yet be fully tightened to allow some reduction maneuvers in both the frontal and sagittal planes.

Figure 1: Image showing tibial pilon racture

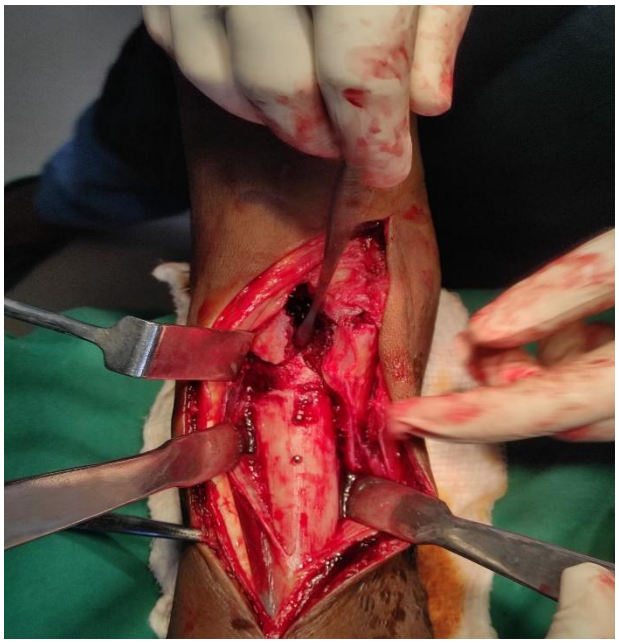

Figure 2: intra-op image of fracture fragments

Figure 3: intra-op image after open reduction and internal fixation

External fixation with combined limited internal fixation
For the group with external fixation with combined limited internal fixation first we will go ahead with fibular plating.

Fibular plating:
The lower fourth of the fibula which is subcutaneous is felt. A linear incision just posterior to the fibula, beginning behind the lateral malleolus and extending up is made, depending on level of fracture and the amount of exposure needed.
Expose the fibula, including the lateral malleolus subperiosteally, strip the muscle off the fibula by dissection proximally. Protect the superficial peroneal nerve. Upon reaching the fracture site the fracture hematoma is drained and the fragments are carefully examined. Fracture edges are debrided to freshen the site. Fracture is provisionally reduced and held with bone holding forceps.

If the fracture is sufficiently oblique, if bone stock is good, and if there is no comminution, fix the fracture with lag screws inserted from anterior to posterior to establish interfragmentary compression. If fracture is transverse, one-third tubular plate placed for fixation after anatomical reduction has been obtained. In earlier case it can be placed as neutralizing plate.

Place three cortical screws in the shaft of the fibula above the fracture and two or three screws distal to the fracture. Unicortical cancellous screws are placed below the level of the plafond.

Skin closure is done in layers.

Spanning external fixator
- Identify point of pin insertion on calcaneum, usually on medial posterior superior portion of calcaneal tuberosity. Make a short incision, separate the soft tissue underneath with a hemostat.

- Insert the drill sleeve and trocar into the pin clamp, and advance it to the cortex. Remove the trocar from the drill sleeve. Drilling both cortices using the appropriate drill bit for the pin. In 4.5mm pin though the sleeve inserted, and bicortical purchase of the screws ensured. Check with image Intensifier.

- Insert another 3.5mm shanz pin in first metatarsal as before. Insert two 4.5mm pin in tibial diaphysis sequentially away from future incision site of distal tibial plating.

- After inserting all half pins, bars were placed connected to pins with AO clamps and tightened sequentially. Both proximal and distal assembly connected with a bar to bar clamp.

- The ankle joint is distracted in neutral position and whole assembly is stabilized by tightening the bar to bar clamp. Afterwards reduction is checked in image intensifier.

After doing the spanning external fixation limited internal fixation is done using either percutaneous cannulated cancellous screw or k-wire.

• After attaining the reduction confirming with IITV fixation is done with either two or three 4.0mm cannulated screws, 4.0mm partially threaded cancellous screws, or with k-wires.

Figure 4: Image showing tibial pilon fracture

Figure 5: Image showing lateral malleoli fixation, medial malleolar screw fixation, percutaneous ccs screw fixation and spanning ankle external fixation.

III. Results

DURATION OF OPERATION

The operating duration in Open reduction and internal fixation ranged from 70-90 minutes (mean 83.00 min) while in case of External fixation with combined limited internal fixation it ranged from 50-70 minutes (mean 63.00 min).

On statistical analysis of both the results, the p-value is found to be <0.05, which is significant.

OPERATIVE BLOOD LOSS

The average operative blood loss in Open reduction and internal fixation was 136ml (range 100-150ml). In case of External fixation with combined limited internal fixation, it was averaging 49ml (range 30-70ml).

On statistical analysis, the p-value is <0.05, which is significant.

INFECTION

Type of operation	Infection	Not infected
ORIF	2	8
LIFEF	1	9
Total	3	17

Table 1: infection rate in both group

The p- value is 0.531 which is not significant.

DELAYED UNION

Type of treatment	Total cases	Delayed union	percentage
ORIF	10	1	10
LIFEF	10	0	0
Total	20	1	5

Table 2: delayed union in both groups

In analyzing all 20 cases, in regards to delayed union in both groups p-value is 0.305 which is not significant.

NONUNION

Type of treatment	Total cases	Nonunion
ORIF	10	0
LIFEF	10	1

Table 3: nonunion in both groups

This difference cannot be shown to be significant in this study (p-value is 0.305).

COMMENCEMENT OF PARTIAL WEIGHT BEARING

PWB	ORIF		LIFEF	
	No	%	No	%
4 weeks	1	10	7	70
6weeks	2	20	1	10
8weeks	6	60	1	10
Delayed and Nonunion	1	10	1	10
Total	10	100	10	100

Table 4: table showing commencement of partial weight bearing in both groups

The p value is 0.038, which is significant. External fixation with combined limited internal fixation group allowed for early partial weight bearing.

UNION TIME

procedure	ORIF	LIFEF
Avg union time(In weeks)	19.80	18.60

Table 5: Table showing union time in both groups

The statistical difference between two groups were not significant.

Figure 6: image showing completely united pilon fracture treated with open reduction internal fixation in 20 week follow up.

Figure7: image showing completely united pilon fracture treated with External fixation with combined limited internal fixation in 18 week follow up.

FUNCTIONAL RESULT

The functional results, as assessed by Johner and Wruh's criteria, showed that majority (n=11, 55%) of the patients in the study had excellent functional results. These differences were not found to be statistically significant (p-value is 0.935) on comparing both groups.

Technique/function	Excellent	Good	Fair	Poor
Open reduction and internal fixation	6	2	1	1
External fixation with combined limited internal fixation	5	2	2	1
Total	11	4	3	2

Table 6: table showing functional results in both groups.

IV. Discussion

In our study, the operating time in the Open reduction and internal fixation group range from 70-90 minutes (mean 83.00), while in case of External fixation with combined limited internal fixation group ranges from 50-70 minutes (mean63.00). This difference is statistically significant p-value <0.05. More time consumed in open reduction and internal fixation.

Considering the partial weight bearing External fixation with combined limited internal fixation group allowed for early partial weight bearing.

The average time of union in the open reduction internal fixation group was 19.8 weeks. In external fixation with combined limited internal fixation group, union occurred in an average of 18.6 weeks. The statistical difference between two groups come out to be insignificant (p value 0.251) We defined union as painless full weight bearing and radiological union of 3 cortices in a standard antero-posterior and lateral x-rays.

Tang R et al[6] in his study reported an average union time of 4.41 months which is comparable to our study.

Only 3(15%) cases were complicated by infection, all 3 were superficial infection. Out of 2 in cases treated with open reduction and internal fixation. 1 superficial infection in a case treated with external fixation with combined limited internal fixation. The p-value is p- value is 0.531, which is not significant.

These superficial infections were treated with appropriate antibiotics (culture and sensitivity proved) and all of them healed uneventfully.

Sirkin et al[7], in a study there were three patients (3/56 = 5.3%) with wound complications, one in closed fractures (1/34 = 2.9%) and two in open fractures (2/22 = 9.1 %). Which were all successfully treated with local wound care and oral antibiotics.

Bahari et al[8] in their study of distal tibial fractures had one case of deep infection and two of superficial infection. Shabbier et al.[9] reported 1 case of superficial infection out of 73 cases in his study of MIPO of close fractures of distal tibia. Borg et al[10] reported 1 superficial infection and 2 deep infections in their group of 21 patients. Singh et al.11 reported 2 (8%) cases of superficial infection in their study. Richards JE et al[12] in their study comparing external fixation versus open reduction and internal fixation for distal intra-articular tibia fracture reported Deep infection in 2 (11.1%) of 18 patients in the external fixation group and 1 (3.7%) of 27

patients in the ORIF group. Roshdy et al[13]reported 2(11.8%) cases of wound dehiscence, 3(17.6%) cases of superficial skin necrosis and 2(11.8%) case superficial infection.

Only one case went to non-union (n=1/20, 5%) which was treated with external fixation with combined limited internal fixation. But this difference cannot be shown to be significant in this study p value is 0.305. No non-union occurred in open reduction and internal fixation group. This was treated with autogenous cancellous bone grafting which get united by 10 weeks period. Wu D et al[14]reported no case cases of non-union and singh et al[15] reported 2 cases of non-union in their study.

In the present study results were evaluated with the help of AOFAS score. On union, 9 out of 20 patients had an AOFAS score of 90 or greater out of possible 100 points. 6 of them were from external fixation with combined limited internal fixation group and 4 from open reduction and internal fixation group. The average score for the external fixation with combined limited internal fixation is 88.00 whereas that for open reduction and internal fixation group is 86.7. The differences were not found to be significant (p- value > 0.780).

V. Conclusion

Our study shows that no significant differences in union time, non-union, malunion or delayed union, superficial and deep infection between the 2 groups. The external fixation with combined limited internal fixation group has less blood loss, less operative time and early partial weight bearing.

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