

Open reduction and Internal Fixation (ORIF) of Posterior Pilon Variant Fractures with Buttress Plate Through Posterolateral Approach

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ABSTRACT

Introduction: Pilon fractures are major group of fractures around the ankle which involves the lower end of tibia bone that forms the ankle joint by articulating with the talus. It is also known as plafond fractures. Posterior pilon variant fracture is characterized by the involvement of both posterolateral and posteromedial malleolar fragment. The aim of this study was to assess the outcome using posterolateral surgical approach in posterior tibial pilon variant fracture using buttress plate.

Material and Methods: The study was conducted for the duration of 2 years from September 1, 2013 to December 31, 2015, 110 consecutive patients with ankle fractures underwent operative treatment at The first affiliated hospital of Zhengzhou University. It was found that 13 fractures in 13 patients with impaction of the posterior tibial plafond were identified as posterior pilon fractures with the help of CT scans and the treatment was done through posterolateral approach with buttress plating. The follow-up was done for all the 13 patients. The clinical outcome was measured with the American Orthopaedic Foot and Ankle Society score (AOFAS) and the visual analogue scale (VAS). The radiological evaluation was done using the osteoarthritis score (OA-score).

Results: All the 13 patients were found with satisfactory and stable fixation. At a mean follow up of 18.5 months, all the patients had good radiological results and showed satisfactory clinical outcome. The mean AOFAS was 90.38, the mean OA - Score was 0.4 and the mean VAS score during, rest, active motion, and weights bearing walking were 0.4, 0.5, and 1.0 respectively. All the fractures were healed and there was no skin breakdown, malunion or delayed union. Accurate reduction was achieved in all patients. No wound complication or hardware irritation was found. No nerve injury was reported in any patients intra-operatively.

Conclusion: Surgeons should be able to handle and treat the soft tissue injury with extra care. No single method of fixation is ideal for all pilon fractures, or suitable for all patients. In the present study, it was found that open reduction and internal fixation of posterior variant pilon fracture with buttress plate through posterolateral approach is a good alternative to the anteromedial approach, if the fracture type is appropriate to use this approach. Buttress plating provides rigid fixation allowing early postoperative mobilisation in patients. Posterolateral approach is safe with satisfactory wound healing without any complications.

Key words: Posterior Pilon Fracture, Posterolateral Approach, Buttress Plate, ORIF

INTRODUCTION

The first use of the term pilon in the literature of orthopaedics is in 1911, by Étienne Destot. It is a French word for pestle, an instrument used for crushing or pounding. Pilon fractures should be classified as the fractures of the distal tibia involving the distal articular surface except medial, lateral and trimalleolar fractures where the posterior malleolus is more than 1/3rd of the articular surface. If isolated fracture of the posterior malleolus which is more than 1/3rd of articular surface should also be called as pilon fracture. It usually affects the bottom of the tibia (shinbone) at the ankle joint.¹ These constitute 1% of all the lower extremity fractures and up to 10% of the tibial fractures and are one of the most difficult types of fracture to manage.^{2,3} The most common reason for these fractures is the result of axial loading, fast axial loading associated with rotational forces from the distal

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metaphysis of the tibia till the articular surface, where joint integrity is disrupted in varying degrees along with enormous dissemination of excessive amount of energy. This energy release causes severe soft tissue injuries in tibial fractures.⁴ Fall from height, motor vehicle accident leading to high degree of disruption to articular surface are the most frequent injury mechanisms. Thus, concomitant injuries are common and should be ruled out. It is most commonly seen in men among 30-40 years old. Surgical treatment of tibial pilon fractures is challenging because of articular comminution, metaphyseal bone loss and serious soft tissue injury. It can be described as independent fracture pattern, which requires meticulous planning in surgical approach and appropriate fixation.⁵

Various advantages and disadvantages have been introduced which includes close reduction, casting, combined intramedullary nailing, plate fixation and minimally invasive plate osteosynthesis. This has been observed from previous studies that posterolateral approach for open reduction and internal fixation of tibial plafond fracture is a better alternative to routine approaches, which has more chances of wound breakdown.⁶

Additionally, this approach demands specific fracture pattern, and is recommended when the comminution is predominantly located in posterior tibia along with fibular fractures and when anterior approach is not suitable because of soft tissue injury. The advantage of this approach are lesser soft tissue complications and ability to fix both fibula and tibia through same incision and also less implant prominence due to sufficient soft tissue coverage.⁷

This term posterior pilon fracture is a combination of the two, where rotational force is combined with axial load. Various operative techniques such as indirect anteroposterior screw-fixation, direct posteroanterior screw-fixation, and buttress plate fixation have been used by different orthopedic surgeons.⁸ Very few studies have been conducted till now regarding factors affecting functional outcomes of tibia pilon fractures treated via open reduction and internal fixation.

Thus, the optimal solution for the posterior pilon variant fracture is limited. Moreover, no consensus has been reported about the best way to treat posterior pilon variant.⁹ This posterolateral approach has been widely accepted in direct reduction and fixation of posterior malleolus.¹⁰ Hence, the aim of this study was to assess the treatment outcomes of 13 patients with posterior pilon fractures treated through posterolateral approach with buttress plate fixation.

MATERIAL AND METHODS

This was a retrospective study which was conducted from September 1, 2013 to December 31, 2015. In this, 110 consecutive patients with ankle fractures underwent operative treatment at our Institution were taken for the study after obtaining written informed consent. Among these fractures, 13 fractures in 13 patients with impaction of the posterior tibial plafond were identified as posterior pilon fractures by CT scans and were treated with buttress plating. Patients with closed fractures without any severe

complications followed by those who were without any severe preoperative nerve injury were included in the study. Patients with open fractures, with severe nerve injury and those with no impaction of the plafond or treated only by the screws and those severe fracture cases like brain injury during accident or other internal organ injury were excluded from the study.

There were 10 males and 3 females with an average age of 46.5 (range, 18 to 71) years. 4 patients had been injured in motor vehicle accidents, 5 patients had fallen from less than 2-meter height, falling from more than one step height while going down stairs 2 patients had twisting injuries whereas at ground level 2 patients had a history of slip and fall only. To evaluate these fractures radiographs of the ankle joint with anteroposterior, mortise and lateral views were taken as well as three-dimensional reconstruction of CT scan images were also used to identify the fracture patterns.

In all the cases, the transverse CT scan images revealed that the fracture lines extended from the posterior malleolus to the medial malleolus. Out of 13 patients, only 9 had complete medial malleolar fractures which involved both the anterior and the posterior colliculi. In all the subjects associated lateral malleolar fractures took place. In the emergency department, plaster splints were given to cases who received closed reduction and fixation. Calcaneal traction was given in 3 cases and external fixator in 2 cases because each of these fractures had a concomitant closed Tschern grade 2 soft-tissue injury.

Postoperative Management

It was found that external splints were not used and after 24 hrs, the active range of motion exercises, took place with gradual increased extent. After 2 weeks, the sutures were also removed. Partial weight bearing started at 6 weeks, followed by full weight bearing at 3 months. It was found on the radiographs that advanced signs of union were seen with mean time from injury to operation was found to be 6.7 days.

Postoperative Assessment

Postoperatively, CT scans were used to determine the quality of fracture reduction. Less than 1 mm articular step off was considered as an anatomical reduction. Radiographs were taken monthly in the first 3 postoperative months during the period of follow-up. After that, patients were generally followed every 3 months, which changed to every 6 months one year later. At the 24 month of follow-up, the functional outcome was checked with the help of American Orthopaedic Foot and Ankle Society score (AOFAS) ankle-hind foot score.¹¹

The visual analogue scale (VAS) which ranged from 0- pain-free to 10- the most unbearable pain. This scale evaluates pain at fracture site during rest, active movement, and weight-bearing walking.¹² The radiological evaluation was done using osteoarthritis-score (OA-score).¹³ A score of 0 was assigned to a normal joint; a score of 1 was given to the presence of osteophytes without joint space narrowing; a score of 2 was allocated to joint space narrowing with or without osteophytes; and a score of 3 was for sub or total

Patient No.	Age (Yr) gender	Mechanism	Associated Lesion	Syndesmotic Screw Fixation	Fixation of PTPF	Approach	Time from injury to surgery (d)
1	18M	FFH	LMF	No	Plate & Screw	PL	7
2	21M	FFH	LMF	No	Plate & Screw	PL	9
3	54M	MVA	LMF	No	Plate & Screw	PL	8
4	47M	FFH	LMF	Yes	Plate	PL	8
5	35F	MVA	LMF	Yes	Plate	PL	10
6	60M	FOS	LMF	Yes	Plate	PL	4
7	42M	MVA	LMF	No	Plate	PL	5
8	40M	FFH	LMF	No	Plate & Screw	PL	7
9	40M	GLF	LMF	No	Plate & Screw	PL	8
10	26M	MVA	LMF	No	Plate & Screw	PL	8
11	26M	FFH	LMF	No	Plate & Screw	PL	1
12	65F	FOS	LMF	No	Plate & Screw	PL	7
13	71F	GLF	LMF	No	Plate & Screw	PL	6

Table-1: Shows distribution of data according to age, gender, associated lesion, syndesmotic screw fixation and time from injury to surgery. F=Female, M=Male, MVA=Motor Vehicle Accident, FOS=Fall On Stairs, FFH=Fall From Height, GLF=Ground Level Fall, LMF=Lateral Malleolar Fracture, PTPF=Posterior Tibial Plafond Fragment, PL=Posterolateral

Patient No	Follow-up (Months)	OA Score	AOFAS Score	VAS Score(rest)	VAS Score (Active movement)	VAS Score (Weight bearing walking)
1	12	0	96	0	0	0
2	15	0	89	0	0	1
3	16	0	98	0	0	0
4	14	0	96	0	0	0
5	15	1	84	1	2	3
6	18	2	82	2	2	3
7	17	0	91	0	0	0
8	12	0	88	0	0	1
9	23	0	92	0	0	0
10	28	0	96	0	0	0
11	26	0	98	0	0	0
12	26	2	81	2	2	3
13	19	1	84	1	1	2
Mean	18.5	0.4	90.38	0.4	0.5	1

Table-2: Shows clinical and radiological outcome on follow-up

disappearance or deformation of the joint space.

RESULTS

In the present study, posterolateral approach was used among all the cases. Syndesmotic screws were used among 3 cases only. Anatomical reduction was achieved among all the cases. Post operatively, immediately CT scan was done for all the patients. Among 13 patients, follow up was done at an average of 18.5 months. Only 1 patient was observed with superficial wound infection and was treated successfully with antibiotics. (Table no.1)

At the end of 13 weeks, all the patients with fractures were healed with no loss of reduction and hardware failure. Postoperatively, after 2 years, mean OA score was found to be 0. The mean AOFAS score was 90.38 (range, 81 to 98). The mean VAS score for fracture pain under different conditions was 0.4(range, 0 to 2) during rest, 0.5 (range, 0 to 2) during active movement, and 1.0(range, 0 to 3) during weight-bearing walking. (Table no.2)

DISCUSSION

Posterior pilon variant fractures are currently challenging

injuries for the surgeons because these rotational injuries may result in an avulsion of the posterior malleolus; usually this posterior fragment contains little or no articular surface damage. However, when rotational forces are combined with axial load, the posterior fragment may be large, comminuted, and may include marginal impaction. The mechanism of injury is so unique fracture pattern could distinguish itself from the above two fractures.¹⁴ It was found that just as in classic pilon fractures, it required 8 days for a soft tissue resolution as seen in the study conducted by Chen's, YuKai wang's et al which also found that posterior pilon variant is not from high energy trauma that requires staged management in pilon fracture.^{15,16}

Besides, the coronal fracture lines found in posterior pilon variant was different from sagittal fracture lines in high energy pilon fracture described in the study done by Topliss et al.¹⁷ On the contrary, the fracture lines were consistent with the fracture map of posterior malleolus and what's more, unlike malleolar fracture caused by low energy torsional force, the independent PM fracture in posterior pilon variant not only extends proximally but also often involves posterior

colliculus of medial malleolus which is 12 out of 16 in this study.¹⁶

Posterolateral approach in prone position which was initially designed for posterior malleolus fracture is the most accepted surgical approach to posterior pilon variant at present. Additional limited posteromedial incision is made only when PM fragments could not be accessed through the posterolateral incision.⁷ But in this study only posterolateral approach was used.

In a study done by Bhattacharya et al he found that complications such as wound problems were reported using posterolateral approach.¹⁸ Moreover, recent cadaveric study showed that with the use of posterolateral incision there is potentially high risk of injuring the perforating branch of peroneal (fibular) artery and the safe distance could be as limited as 41 mm. With the single posterolateral incision, it is very difficult to manipulate both PL and PM, as either the attachment to deltoid ligament or also the entrapment of soft tissue may prevent PM fragment from anatomical reduction.¹⁹

A study conducted by Calori et al stated that pilon fractures can be of different types such as partial or complete, the partial can be divided into anterior and posterior, and the posterior were usually only one large fragment. Mast et al evaluated that axial load combined with rotational load could cause a large posterior plafond fracture and viewed these injuries as pilon fractures because of the involvement of a large weight-bearing surface.^{20,21}

In a study carried out by Huber et al found that larger the posterior malleolar fragment and the further the medial extension of the fracture line, the closer seems the relationship is with pilon fractures. From these studies we can find that, fractures of the posterior pilon are not uncommon. Hansen used the term posterior pilon to describe severe trimalleolar fractures which involve posterior tibial plafond with an impacted fragment.^{22,23}

The study performed by Amorosa et al concluded that a posterior pilon fracture is a unique fracture pattern with longer postoperative course and slower functional recovery than standard ankle fractures. It not only involves large posterior malleolar fragment but is also related to medial and lateral malleolar fractures. CT scans could reveal marginal impaction and comminution of the posterior fragments. It is very important to differentiate posterior pilon fractures and posterior malleolar fractures due to the difference in therapeutic protocols and prognosis. Radiographic plain films cannot provide enough information and that's why CT scan is must for identifying a posterior pilon fracture.⁷

A study conducted by Buchler et al showed that assessment of the fracture anatomy based on plain radiography at the posterior tibial margin underestimated by far the posteromedial extension of the fracture line, the impaction of the posterior fracture edge, and additional impacted osteochondral fragments. In this study, preoperative CT evaluation was available for all the patients.²⁴ In all the patients, posterior marginal impaction or impacted fragments were found. Also, the CT scan helped to evaluate

the predominant location of the fragments. In our study all the fragments were posterolateral, so only one incision was used for both tibial and fibular fixation.

Anatomical reduction of the posterior malleolus is the goal of surgical treatment of posterior pilon fractures to limit the articular degenerative changes and improve the outcomes. The posterolateral approach could provide excellent exposure and direct visualization of the large posterior articular fragment as well as the smaller impacted fragments, thus allowing better reduction.

In our study, we chose buttress plating in 4 cases and buttress plating and screw together in 9 cases and all fractures gained stable fixation. The major drawback of this approach while reducing posterior malleolus is poor visualisation of ankle joint which was to rule out articular congruency. Hence C-arm guidance was used for reducing this fragment to check articular step. Due to the disadvantage of poor visualisation of ankle joint when compared with anteromedial approach, this approach demands a very specific and particular fracture pattern.

Limitations of this study included the intrinsic weakness of a retrospective study, a lesser sample size of patients, and lack of powerful statistical data and short time period of follow up to reveal the advantage of buttress plating and advantages of posterolateral approach. In addition, we could not thoroughly compare our results with other reports. This could be due to the facts that most of the posterior pilon fractures were mixed up with posterior malleolar fractures to be reported. But our all patients got proper management and achieved favourable clinical and radiological outcomes.

CONCLUSION

There is no single method of fixation is ideal for all Pilon fractures or suitable for all patients. The present study concludes that open reduction and internal fixation of posterior variant Pilon fracture with buttress plate through posterolateral approach is a good alternative to the anteromedial approach, if the fracture type is appropriate to use this approach. Buttress plating provides rigid fixation allowing early postoperative mobilisation in patients. Posterolateral approach is safe with satisfactory wound healing without any wound complications. We suggest that posterolateral approach provides optimal exposure for the posterior pilon variant fractures and surgeons could get advantage from this under-appreciated approach.

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