



TO STUDY THE FUNCTIONAL OUTCOME OF PILON FRACTURES MANAGED SURGICALLY WITH DELTA EXTERNAL FIXATOR AS A DEFINITIVE MANAGEMENT.

Orthopaedics

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ABSTRACT

Background: Distal tibia fractures are 2nd in prevalence subsequent to tibia diaphyseal fractures. These fractures are high velocity injuries having severe soft tissue damage. Giving priority to anatomical reduction or soft tissue management is still a questionable at present which makes the management of these fractures difficult. The following study was undertaken in an attempt to study the functional outcome of pilon fractures managed surgically with delta external fixator as a definitive management. **Methods:** A prospective study was conducted in Tertiary Health Care Center, Surat from April 2020 to August 2021. The Study was a series of 25 skeletally mature patients with distal tibia fractures (Pilon fracture) and was operated for Delta External fixator. Prior approval from the Institutional Ethical Committee was obtained. All patients were explained clearly about the study and an informed consent was obtained from each of them. **Results:** In this study with the help of Delta frame we achieved 76% good to excellent result in high velocity trauma injury. It was observed in the present study that the average union time of this type of fracture treated with delta frame was 22 weeks. Pin tract infection followed by ankle stiffness was the most common complication observed in the present study. **Conclusions:** Overall, delta external fixator is mechanically and biologically an advantageous implant in comminuted pilon fracture and in osteoporotic bones in elderly patients. In conclusion, Delta external fixator is a relatively good construct and a stable implant to use for the comminuted pilon fractures.

KEYWORDS

Delta external fixator, Comminuted pilon fracture, Distal tibia fibula fracture.

INTRODUCTION

The speedy boom of era and urbanization has brought numbers of vehicles on the roads. This has brought increase in accidents and deaths. Globally deaths due to Road traffic accident are estimated at 1.3 millions every year as reported by WHO (World Health Organization). Yearly numbers of injured person due to Road traffic accident goes up to 50 millions¹.

The damage because of those injuries usually involves the long bones mainly tibia because of its subcutaneous location. Distal tibia fractures are 2nd in prevalence subsequent to tibia diaphyseal fractures. These fractures are high velocity injuries causing severe soft tissue damage. Giving priority to anatomical reduction or soft tissue management is still a questionable at present which makes the management of these fractures difficult.

Orthopaedicians have to face number of challenges like malunions, delayed union, non-union and wound problems due to its subcutaneous position, poor soft tissue covering and decreased vascularity. Good articular anatomical reduction, alignment restoration along with early ankle mobilization has been shown to be effective in most of the distal tibia fractures. Multiple options of the treatment include open reduction and internal fixation, joint spanning external fixator, Ilizarov fixator. The aim of the treatment is finally towards the stable construct that can maintain the reduction for the time period the treatment. The wound healing complications and infection should be decreased by careful soft tissue management & not operating through compromised soft tissue.

Considering the advantages and the scarcity of data on the efficacy and the functional outcome following external fixator in intra-articular distal tibia pilon fracture and in order to justify, criticize, document, and compare the results of external fixator in distal tibia pilon fracture, this study was planned.

MATERIAL AND METHODS

(1) Study design, sample size and Period:

A prospective study was conducted in Tertiary Health Care Center, Surat from April 2020 to August 2021. The Study was a series of 25 skeletally mature patients with distal tibia intra articular fractures (Pilon fracture) and was operated for Delta External fixator. Prior approval from the Institutional Ethical Committee was obtained. All patients were explained clearly about the study and an informed consent was obtained from each of them.

1. Inclusion Criteria:

- Patients >18 years of age
- Distal tibia plafond fractures in skeletally mature patient
- Patients with open & closed fractures
- Patients willing to undergo surgery
- Consent for surgery and to participate in the study

2. Exclusion Criteria

- Patients less than 18 years of age
- Patients not willing for Surgical intervention
- Pathologic fracture, Old neglected fractures & Revision surgeries
- Refusal to provide informed consent
- Fractures with neuromuscular disorders / neurovascular insufficiency

A careful history was taken from the patients and/or attendants to know the mechanism of injury and the severity of trauma. Detailed examination of swelling, deformity, distal neurovascular deficit was looked for and noted. Patient posted for surgery were subjected to routine investigation and were referred to physician for fitness for surgery. In preoperative planning pre-operative x-ray were taken antero-posterior and lateral views including knee and ankle joint. Consent for surgery was taken.

Surgical Procedure:

Patient is placed in supine position and the entire limb is prepared and draped. Under Image intensifier fracture manipulation is done and reduction achieved. Fibular fixation is done prior to tibial reduction in case of tibia and fibula fractures were there. Tibial pin is inserted proximal to fracture and just medial to anterior tibial crest. Transcaneal pin is inserted from medial to lateral starting 2 cm inferior to medial malleolus and 2 cm anterior to posterior border of calcaneum. Tibial pins with bar, creating stable base is spanned. Final AP and lateral radiographs are taken.

RESULTS

Mode of Injury:

Table 1 Mode of Injury

Age Group	Mode of Injury			
	RTA	Fall from Height	Fall of Heavy Object	Domestic fall
21-30	2	1	1	0
31-40	4	3	0	0

41-50	5	3	1	0
51-60	1	1	0	1
>60	2	0	0	0
Total	14	8	2	1

The most common mode of injury is motor vehicle accident. There were 14 open fractures and 11 closed fractures.

Time spent in External Fixator:

Table 2 Time spent in External Fixator

Time spent in External fixator in days		
Days	Numbers of Patients	Percentage (%)
40-49	07	28
50-59	10	40
60-69	6	24
>70	2	8

In 40% of the patients external fixator was removed between 50-59 days. Only 2 patients had external fixator for more than 70 days due to complication like non-union and flap surgery. External fixator was removed on average of 56 days.

Complications:

Table 3 Complication assessment

Complication Assessment		
Complications	Number of Patients	Percentage (%)
Pin Tract Infection	9	36
Neurovascular Injury	0	00
Ankle Stiffness	7	28
EHL Weakness	6	24
Mal Union	3	12
Delayed Union	2	8
Non Union	1	4
No Complications	7	28

There were 9 patients having pin tract infection. 7 patients had ankle stiffness. Out of 25 patients 7 patients had no complications at all. 1 patient had complication of non-union which was later treated with open reduction internal fixation and bone grafting.

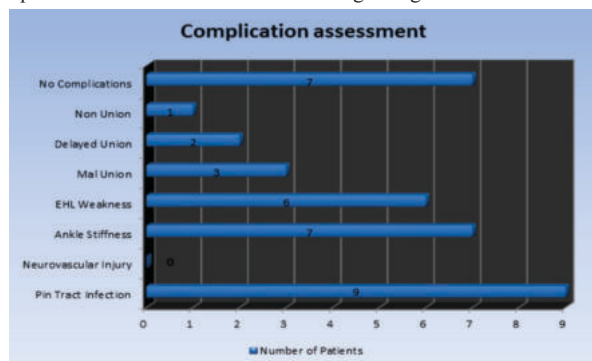


Chart 1 Complications assessment

Association of functional outcome using Ovadia & Beals Scoring Criteria with Union time.

Table 4 Association of functional outcome with Union time.

Union time	Ovadia & Beals Scoring Criteria				Total
	Excellent	Good	Fair	Poor	
10-14	0	3	0	0	3
	0%	100%	0%	0%	100%
15-19	1	3	1	0	5
	20%	60%	20%	0%	100%
20-24	3	6	3	0	12
	25%	50%	25%	0%	100%
25-29	1	1	0	0	2
	50%	50%	0%	0%	100%
30-34	0	1	1	0	2
	0%	50%	50%	0%	100%
35-39	0	0	0	0	0
	0%	0%	0%	0%	0%
>40	0	0	0	1	1
	0%	0%	0%	100%	100%

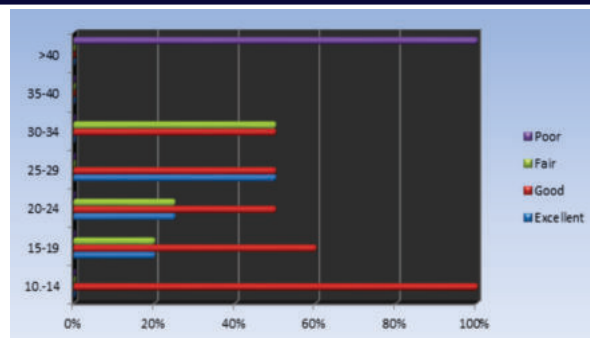


Chart 2 Association of functional outcome with Union time

The duration of surgery ranged from 40 to 110 minutes averaging 83 minutes. The operating time reduced with fractures having lesser grade as per AO/OTA classification increasing experience of the operating surgeons in fixing these fractures.

Results were evaluated using Ovadia & Beals Scoring Criteria at 12 months follow up in which it was observed that majority of the patients (56%) had a good functional outcome while only 24% had a fair to poor functional outcome.

Outcome Evaluation:

Table 5 Outcome Evaluation:

Outcome Evaluation		
Final Outcome	Number of Patients	Percentage (%)
Excellent	5	20
Good	14	56
Fair	5	20
Poor	1	4

Results were evaluated using Ovadia & Beals Scoring Criteria at 12 months follow up in which it was observed that majority of the patients (56%) had a good functional outcome while only 24% had a fair to poor score.

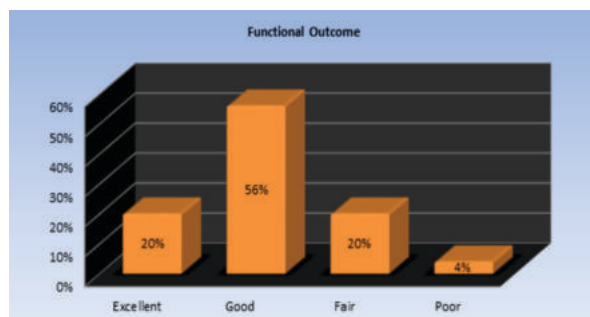


Chart 3 Functional Outcome

DISCUSSION

Distal tibia intra-articular pilon fractures are one of the most difficult fractures to treat due to its subcutaneous location. The final results depend on the extent of soft tissue damage, degree of comminution and articular damage. Providing of stability along with achieving anatomical reduction is the prime aim of the surgery. This should be accomplished using procedures that decrease osseous and soft tissue devascularization. External fixator is one such modality.

The present study was taken to determine the functional outcome of the delta external fixator in pilon fracture and to evaluate our results and various factors affecting the outcome of the results with the previous study. In the present study, delta external fixation in intra articular distal tibia pilon fractures resulted in acceptable functional outcome and low complications. The average age of patients in our study with such injuries is to be 43.32 years with the minimum age from 24 to maximum age of 72 years which is comparable to that of other studies. In the study by Tornetta² et al the average age of the patients was 41.81 years while in Mayil Natarajan³ study the average age of the patients was 36.5. Zemen⁴ et al study had average age of the patients of 49.2 years.

Male preponderance is slightly high in our study (64%) as compared to the study by Barbieri⁵ et al, which was 59%. In the study by Zemen et al

there was male preponderance where the number of male was 16 to that of 5 female. Stable fixation in osteoporotic bone is one of the advantage of external fixator that is why most of the patients of age >50 years had good functional outcome in our study.

93% of the fractures were due to high energy trauma in study of Gaudinez². While in study of Ovadia and beals they observed that only 46% of the pilon fractures were due to high energy trauma. In the study of Agarwal¹ et al It was observed that 87% of the patients who had pilon fractures were due to high energy injuries. In present study 56% of the patients were having pilon fractures due to RTA (Road Traffic Accident) which is highest among any other cause.

In the present study 56% of the open fractures were observed which is comparable to the study conducted by Guadnez. Ovadia and beals reported 20% of the oprn distal tibia pilon fractures while barbieri et al observed 30% of the open distal tibia pilon fractures.

In our study we had 20% patients with B1 fractures who showed excellent to good outcome while good outcome can be seen in type B2 fractures. Study by barbieri et al had 9% A1, 9% A2, 10% A3, 16% C1, 32% C2 and 24% C3. Similar results were seen n the study by Kevin et al. In our study 20% B1, 12% B2, 4% B3, 20% C1, 36% C2 and 8% C3 type of fractures observed.

76% of the patients had a fibula fractures associated with tibia pilon fractures. Fibular length restoration was done in all the patients with fibula fracture either by rush nail or by platting. Decision of platting was done by the level of the fracture whether it was at or below the level of syndesmosis as suggested by several studies.

In the present study we had 25 distal tibia intra-articular pilon fractures managed by delta external fixator, except 1 patient, all the other patients had average union time of 21.88 weeks. Pin tract infection was the most reported complications in the present study followed by ankle stiffness and EHL weakness. 9 patients had pin tract infection while 7 patients had ankle stiffness. 1 patient reported with the non-union.

Table 6 Outcome Evaluation

	Excellent	Good	Fair	Poor
Aggarwal et al	26	50	14%	10%
Zemen et al	26 %	32%	26%	16%
Mayil Natarajan et al	50%	20%	15%	15%
Present study	20%	56%	20%	4%

CONCLUSION

Pilon fracture is intra-articular distal tibia fracture cause by high velocity trauma mostly due to road traffic accident. Soft tissue management and anatomical articular reduction are the main concern in treatment of the pilon fracture. Delta external fixator is stable construct that used to treat the pilon fracture which helps in managing the soft tissue better. In case of open pilon fracture with significant soft tissue damage, Delta External fixator provides relatively good result. Delta External fixator helps in treating the soft tissue damage and preventing the further soft tissue damage. It gives good access to soft tissue and wound care. Delta external fixator prevents the complications compare to that of open surgical fixation method. Fixation of the fibula by rush nail or platting gives additional stability to the delta frame by keeping the fibular length intact.

The present study was done to evaluate functional outcome and complication following surgical management of distal tibia pilon fracture treated with delta frame. In this study with the help of Delta frame we achieved 76% good to excellent result in high velocity trauma injury. It was observed in the present study that the average union time of this type of fracture treated with delta frame was 22 weeks. Overall, delta external fixator is mechanically and biologically an advantageous implant in comminuted pilon fracture and in osteoporotic bones in elderly patients.

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