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Functional results of compound extra articular tibial pilon fractures managed with hybrid external fixator

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ABSTRACT

Background: Distal tibia fractures are difficult to treat. It is often difficult to assess the potential risk of surgical complications because of the variations in the clinical findings. Less subcutaneous tissue, limited blood supply and no muscle insertions are the factors that tend to make the healing of the soft tissue more complex. Compounding presents a great challenge for the treating surgeon regarding the treatment options.
Methods: A total of 23 patients were included in the study based on the inclusion and exclusion criteria and were managed by hybrid external fixator as definitive treatment. They were kept in follow up for at least 6 months and were assessed using Ovadia and Beal's objective and subjective scoring.
Results: All patients achieved fracture union with 82% patients reporting excellent to good functional outcome. Pin site infections and ankle stiffness were most common complications.
Conclusions: A very good outcome is achieved in compound extra articular tibial pilon fractures with the hybrid fixator technique. Adequate stability is provided and hence early motion and ambulation can be started.

Keywords: Distal tibia, Tibial pilon, Extra articular fracture, Compounding, Hybrid external fixator

INTRODUCTION

Distal tibia fractures are difficult to treat. While treating distal tibial fractures, the main aim is to achieve normal axial and angular alignment. Previously, surgical intervention was not considered as an option for this injury due the severity of the complications associated with fracture and its treatment.[1] Even the classifications used for the fracture didn't address the soft tissue involvement and judged severity only on the basis of fracture pattern.[2] Extra-articular fractures are associated with less complications after surgery as compared to intra-articular fractures but the seriousness of soft-tissue injury in the distal region increases the chances of complications when compared to mid-shaft tibial fractures.[3,4] Less subcutaneous tissue, limited blood supply and no muscle insertions are the factors that tend to make the healing of the soft tissue more complex, and increases the chances of compounding at the fracture site due to high-energy trauma on this segment (20%-25% of these fractures are open).[5] Compounding presents a great challenge for the treating surgeon regarding the treatment options. Various surgical methods for fixing tibial pilon include external fixation, intramedullary nailing, the percutaneous plating with cannulated wires or Kirschner's wires and a synthesis with modern plates.[6] In presence of compound injury with compromised soft tissue external fixators are preferred method of emergency treatment. The use of hybrid external fixator in the management of the tibial pilon fractures combines the advantage of pin fixator and the ring fixator. The procedure of application of a hybrid fixator has a small learning curve and very little soft tissue

compromise is expected.[7] The option of external fixation as a definitive treatment has been preferred in recent years, particularly for the benefits it provides with respect to minimal interference with the soft tissue. The objective of the present study was to investigate whether the hybrid external fixation can be used as a definitive treatment modality in the management of compound distal tibial extra articular pilon fractures of the adults in emergency.

METHODS

This study includes all the patients who were managed with hybrid external fixator of compound extra articular tibial pilon fractures in the department of orthopedics', government medical college, Jammu from January, 2019 to August, 2020 were included in the present study. The study was a prospective observational type of study.

Inclusion criteria

Inclusion criteria included age of patients above 20 years, compound type 2 or 3 (a or b) and isolated extra articular displaced fractures of tibial pilon (AO 43-A1, A2, A3).

Exclusion criteria

Exclusion criteria excluded age of patients below 20 years, compound type 3c, intra-articular fractures of distal tibia and un-displaced fractures

A total of 23 patients were included in the study, based on the inclusion and exclusion criteria. The sample of 23 patients included all the patients who presented in the emergency and out patients' clinics with open extra-articular tibial pilon fractures who were managed with hybrid external fixators. An informed written consent was obtained from all the study participants after explaining the nature of the study in their local language.

After initial stabilization of the patient, a careful history was elicited from the patient and/or attenders to reveal the mechanism of injury and the severity of the trauma. The patients were then assessed clinically to evaluate their general condition and the local injury. General condition was assessed with the vital signs and systemic examination. Methodical examination was done to rule out fractures at other sites.

open fractures were graded using the Gustilo Anderson classification for open fractures. Antibiotics were started immediately for all patients. Injection cefuroxime 1.5-gram intravenous twice daily along with injection amikacin 500 mg intravenous twice daily were the antibiotics. Single dose of tetanus toxoid was given.

Open fractures were treated by cleaning of the wound with copious amount of normal saline, and Hydrogen peroxide, followed by painting of the skin around the wound with povidone iodine and surgical spirit. The limb was then immobilized in an above knee plaster of Paris slab till definite fixation was done. Appropriate radiographs and blood investigations were obtained. The fractures were classified according to the AO classification and open fractures were classified according to Gustilo.[8-10] Patient was taken for wound debridement and closure, if possible, and hybrid external fixator application

Operative procedure

All patients were evaluated and preoperative assessment was done. All patients were operated under spinal anaesthesia. All fractures were debrided. Hybrid fixator construct used in the study was made of a single ring external fixator assembled with tensioned trans fixator wires in distal fragment. The proximal fragment of the fracture was held in position by tubular external fixator and Schanz pins. Under fluoroscopic control or direct vision, fracture was manipulated and provisional reduction was checked. Fibular fixation was done in cases where level of fibula fracture is at or below the level of syndesmosis. Fibular fixation was done with open reduction and plating or intramedullary rush nail.

Periarticular fragment was reduced with pointed reduction forceps and secured by three Ilizarov wires placed through safe corridors. Olive wires were used when interfragmentary compression was aimed. Wires were checked for any tendon impalement and revised. The wires were fixed to the rings using slotted wire fixation bolts and tensioned. The AO tibial external fixator pins were used for holding diaphyseal fragment. Two to three Schanz pins were used. Fracture reduced and AP/lateral angulations in distal fragment and verified. The AO rod is connected to the ring by twisted connecting plate or male post with AO Clamp modified and connected to each other. All nuts and bolts were tightened. Wound, if possible, was closed or stay suturing was done or if required skin grafting was done. In 2 cases rotational flap was done later.

Post-op regimen

Active mobilization of the ankle, knee and non-weight bearing walking using standard walking frame was done from the second post-operative day Intravenous antibiotic regimen was continued for 10 days after the surgery or more as per status of wound.

Another 5 days of oral antibiotics were advised. Regular cleansing of the pin exit points was done. Patients were encouraged to do non weight bearing walking.

Follow up

Patients were followed up once in three weeks until fracture union and once in three months after that. Fixator was removed after 8 weeks if frank mobility was not present or radiologically soft callus was present. After fixator, PTB was applied and kept till union. Patients were evaluated with objective and subjective parameters as

described by Ovadia et al at six months and then compared with different studies.[11]

The statistical tools used in the study include percentage, range and mean.

RESULTS

The present study consists of 23 cases of extra articular fracture of the tibial pilon. All the cases were fixed using the hybrid external fixator. The study period was from January 2019 to August 2020. The age of the patients ranged from 26-67 years with the fracture being most common in the age group of 30 to 40 years and an average age of 47.5 years. Out of 23 patients, 17 (74%) patients were males and 6 (26%) patients were females showing male preponderance because of traveling and working in fields and factories. There were 9 (39.2%) patients with right distal tibia fractures and 14 (60.8%) patients with left distal tibial fractures.

In our study, 18 (78%) of patients sustained injury following road traffic accident, 3 (13%) patient sustained injury following fall and 2 (9%) had history of trauma due to falling of heavy object on leg. All the open fractures were classified based on Gustillo Anderson classification of open fractures, 10 (44%) were type 2 compound while 13 patients were type 3 compound, out of which 9 (39%) were type 3a and 4 (17%) were type 3b. The fracture pattern was classified based on AO/OTA classification for fractures of distal tibia of the 23 cases studied, 5 (22%) cases were A1, 8 (35%) were A2, 10 (43%) were A3. 11 of 23 cases studied had an associated fracture of the fibula. The 3 cases with intact fibula had to be osteotomized to give adequate compression at the tibial fracture site. One patient had a fracture distal end of radius on the contralateral side of the injury which was treated by closed reduction and below elbow cast. Out of 11 cases of fracture fibula, 5 were of distal third which required fixation. 3 were fixed with plating while 2 were stabilised with rush nail. The fixators were removed at an average of 8 weeks.

Table 1: Major observations of study.

Criteria	Avg/most common (%)
Age of patients (year)	47.5
Sex	Male (74)
Side	Left (60)
Mode of injury	RTA (78)
Gustillo Anderson classification	Type 3 (56)
AO/OTA classification	43-A3 (43)
Fixator removal	8 weeks
Fracture union	14.3 weeks

In 2 patients, the fixator was removed earlier (7 weeks) as they had pin tract infections. After removal of fixator, PTB was applied. Average time taken for union in our study was of 14.3 weeks (Range; 12-18 weeks). There was no delayed union or non-union. Fractures of 5 (21.7%) patients united in 12 weeks, 10 (43.4%) patients united in 14 weeks, 7 (30.4%) fractures united in 16 weeks and in 1 (4.3%) patient the fractures united in 18 weeks.

The study characteristics have been tabulated in Table 1.

The results were based on the objective and subjective parameters as described by Ovadia and Beals.[11] At the end of 6 months, out of 23 patients treated, 9 (39%) patients had excellent outcome, 10 (43%) had good results, 3 (13%) had fair outcome and 1 (4%) patient had a poor result as per objective examination (Table 2).

Table 2: Ovadia and Beals objective evaluation.

Result	Patients	Percentage (%)
Excellent	9	39
Good	10	43.4
Fair	3	13
Poor	1	4.3

On subjective evaluation**,** out of 23 patients treated, 10 (43%) patients had excellent outcome, 10 (43%) had good results, 2 (9%) had fair outcome and 1 (4%) patient had a poor outcome (Table 3).

Table 3: Ovadia and Beals subjective evaluation.

Result	Patients	Percentage (%)
Excellent	10	43.4
Good	10	43.4
Fair	2	8.6
Poor	1	4.3

There were no cases of intraoperative complications. Post-operative complications included pin site infection which were managed with culture sensitivity and appropriate antibiotics, ankle stiffness, anterior angulation and valgus malunion (Table 4).

Table 4: Post-operative complications.

Complications	Patients	Percentage (%)
Pin site infection	5	22
Ankle stiffness	7	30
Anterior angulation	2	8
Valgus malunion	1	4

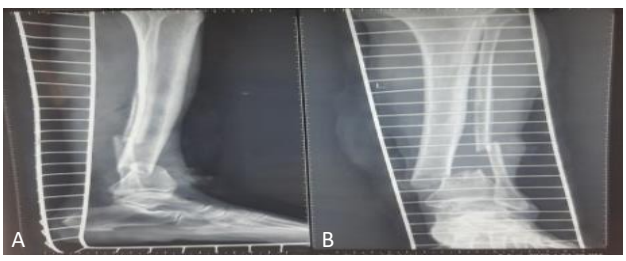

Figure 1 (A and B): Pre-operative radiograph.

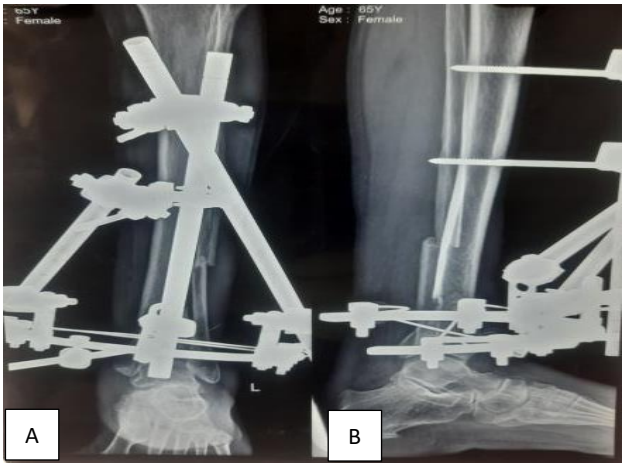

Figure 2 (A and B): Post-operative radiograph.

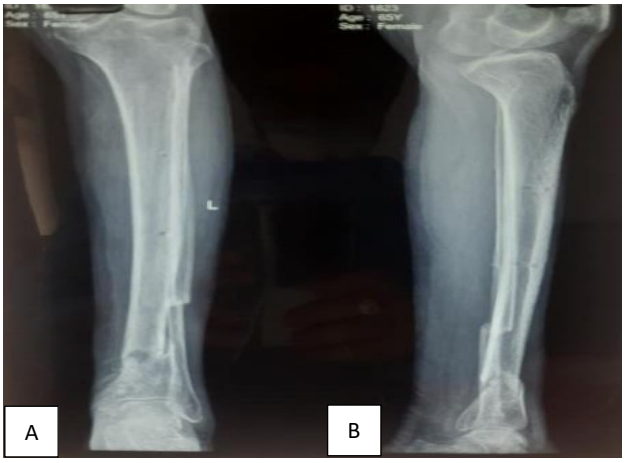

Figure 3 (A and B): Radiograph of union.

DISCUSSION

Distal tibia fractures are one of the most difficult fractures to treat. The soft tissue status, the degree of comminution and articular damage sustained determines the final results. The aim of surgery is to obtain anatomic reduction and providing stability. The present study was under taken to determine the efficacy of the hybrid external fixator in treatment of the extra articular fractures of the tibial pilon. Our study revealed the average age of patients with such injuries to be 47.5 years (Range 26 to 67 years) which is comparable to that of other studies like study by Barbieri et al where average age was 39 years and by Rathod et al with average age of 41 years.[7,12]

In our study, the males were more in number (74%) as compared to females (26%). This is compareable to the study by Barbieri et al and Ovadia et al, which showed male preponderance with 59% and 67% male patients.[11,12]

In terms of mechanism of injury, our present study correlates with the study conducted by Agarwal et al and Barbieri et al who had 87% and 75% patients respectively with high energy injuries.[12,13] In our study road traffic accident (78%) was the predominant mode of injury.

Our study had an average fracture union of 14.5 weeks which was comparable with studies conducted using the hybrid external fixator. Barbieri et al had an average fracture union of 16 weeks and Gaudinez et al had an average of 13 weeks.[12,14] It is also comparable with time taken with other methods of fixation (Table 5).

Table 5: Time taken for fracture union in various studies.

Study	Time to union in weeks
Barberi et al[12]	16
Guandinez et al[14]	13
Bone et al[15]	14
Tornetta et al[16]	17
Our study	14

Functional outcome was compared on the basis of objective score of Ovadia et al.[11] In our study, 9 (39%) patients had excellent outcome, 10 (43%) had good results, 3 (13%) had fair outcome and 1 (4%) patient had a poor result as per objective examination. Aggarwal et al in their study of hybrid external fixation of high energy peri articular fractures of the tibia had results that were good to excellent in 30 (86%), fair in 2 (6%) and poor in 3 (8%) whereas Zeman et al in a study of using hybrid external fixators for periarticular fractures of the tibia obtained 5 excellent (26%), 6 very good (32%), 5 satisfactory (26%) and 3 poor results (16%).[13,17] Gaudinez et al based their study on distal tibia fractures, using the scale by Ovadia et al, they had 64% patients having good to excellent objective results.[11,14] Using the technique of hybrid external fixator, Tornetta et al accomplished 69% good results in the high energy injuries and major complications were avoided (Table 6).[16]

Table 6: Comparisons with previous studies.

Study	Good to excellent outcome (%)
Tornetta et al[16]	69
Gaudinez et al[14]	64
Barbieri et al[12]	61
Aggarwal et al[13]	76
Zeman et al[17]	58
Present study	82

Better results in our study can be attributed to inclusion of only extra articular fractures which have better outcome than intra-articular fractures.

Limitations

The limitations of this study include relatively small sample size and duration of follow up.

CONCLUSION

The study shows that it is possible to achieve a satisfactory outcome in compound extra articular tibial pilon fractures with the hybrid fixator technique. It provided adequate stability and allows early motion and ambulation. The fractures were treated immediately after the injury, regardless of soft-tissue damage. This method limits further damage to the already compromised soft tissue.

It is effective in extra articular fractures occurring within 5 cm of the joint because extensive soft tissue dissection and in case of compound injuries risk of infection increases manifold therefore limiting the use of any other implant.

Therefore, external hybrid fixator can be used as a definitive treatment modality for these fractures.

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