

A Prospective Research to Evaluate the Functional Outcomes of Complex Extra Articular Tibial Pilon Fractures Treated with A Hybrid External Fixator System

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Abstract

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

Methods: This prospective study conducted in the Department of Orthopaedics, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga, Bihar, India, for 15 months. 50 patients were included in this study. The 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).

Results: There were 20 (40%) patients with right distal tibia fractures and 30 (60%) patients with left distal tibial fractures. In our study, 40 (80%) of patients sustained injury following road traffic accident, 5 (10%) patient sustained injury following fall and 5 (10%) 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, 20 (40%) were type 2 compound while 30 patients were type 3 compound, out of which 20 (40%) were type 3a and 10 (20%) were type 3b. The fracture pattern was classified based on AO/OTA classification for fractures of distal tibia of the 50 cases studied, 10 (20%) cases were A1, 18 (36%) were A2, 22 (44%) were A3. Average time taken for union in our study was of 14.5 weeks. At the end of 6 months, out of 50 patients treated, 20 (40%) patients had excellent outcome, 22 (44%) had good results, 5 (10%) had fair outcome and 3 (6%) patients had a poor result as per objective examination. On subjective evaluation, out of 50 patients treated, 22(44%) patients had excellent outcome, 22(44%) had good results, 4 (8%) had fair outcome and 2(4%) patients had a poor outcome.

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 allowed early motion and ambulation. The fractures were treated immediately after the injury, regardless of soft-tissue damage.

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

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Introduction

The difficulty in treating the fractures of distal tibial end is exemplified by orthopaedic, who in the first half of twentieth century, believed these injuries were so severe and fraught with so many complications, that the fracture was deemed not amenable for surgical reconstruction.[1] Distal tibial fractures represent a significant challenge to most of the surgeons even today. They are only 1-10% of all lower extremity fractures[2] The low energy type of fractures often get dramatic results with open reduction and internal fixation. But high energy fractures are documented to show a high amount of complications due to soft tissue coverage, skin necrosis, infections and also the usually comminuted nature of the fractures[3]

Conservative treatment by cast application lead to prolonged immobilization, leading to ankle and knee stiffness affecting quality of life of the patient[4] Introduction of the external fixator was a revolution in the evolution of management of fractures. It has undergone a sea of change from a simple frame to a more complex frame and various pin arrangements. The Hybrid External Fixator combines the advantages of the monolateral pin fixators and the circular Ilizarov wire fixators. The tensioned wires provide improved fixation in the small distal cancellous fragment, whereas the pin fixators give adequate stability to the proximal fragment. It is simple, has a rapid and straight forward application, reduced surgical time and is minimally invasive. It is adjustable; hence fracture reduction can be easily attained after frame assembly.[5] Along with rigid fixation, it allows immediate mobilization of the knee and ankle joints and early weight bearing. "Early motion has been touted as the functional savior of major intra articular injuries"[6,7]

Material and Methods

This prospective study conducted in the Department of Orthopaedics, Darbhanga

Medical College and Hospital, Laheriasarai, Darbhanga, Bihar, India, for 15 months, after taking the approval of the protocol review committee and institutional ethics committee.

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 undisplaced fractures

Methodology

A total of 50 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 outpatients' 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 50 cases of extra articular fracture of the tibial pilon. All the cases were fixed using the hybrid external fixator. The age of the patients ranged from 27-68 years with the fracture being most common in the age group of 30 to 40 years and an average age of 48.5 years.

Out of 50 patients, 36 (72%) patients were males, and 14 (28%) patients were females showing male preponderance because of traveling and working in fields and factories. There were 20 (40%) patients with right distal tibia fractures and 30

(60%) patients with left distal tibial fractures.

In our study, 40 (80%) of patients sustained injury following road traffic accident, 5 (10%) patient sustained injury following fall and 5 (10%) 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, 20 (40%) were type 2 compound while 30 patients were type 3 compound,

out of which 20 (40%) were type 3a and 10 (20%) were type 3b. The fracture pattern was classified based on AO/OTA classification for fractures of distal tibia of the 50 cases studied, 10 (20%) cases were A1, 18 (36%) were A2, 22 (44%) were A3. Out of 20 cases of fracture fibula, 10 were of distal third which required fixation. 6 were fixed with plating while 4 were stabilised with rush nail. The fixators were removed at an average of 8.5 weeks.

Table 1: Major observations of study

Criteria	Avg/most common (%)
Age of patients (year)	48.5
Sex	Male (72)
Side	Left (60)
Mode of injury	RTA (80)
Gustillo Anderson classification	Type 3 (60)
AO/OTA classification	43-A3 (44)
Fixator removal	8.5 weeks
Fracture union	14.5 weeks

Average time taken for union in our study was of 14.5 weeks (Range; 12-18 weeks). There was no delayed union or non-union. 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 50 patients treated, 20 (40%) patients had excellent outcome, 22 (44%) had good results, 5 (10%) had fair outcome and 3 (6%) patients had a poor result as per objective examination (Table 2).

Table 2: Ovadia and Beals objective evaluation

Result	Patients	Percentage (%)
Excellent	20	40
Good	22	44
Fair	5	10
Poor	3	6

On subjective evaluation, out of 50 patients treated, 22(44%) patients had excellent outcome, 22(44%) had good results, 4 (8%)

had fair outcome and 2(4%) patients had a poor outcome (Table 3).

Table 3: Ovadia and Beals subjective evaluation

Result	Patients	Percentage (%)
Excellent	22	44
Good	22	44
Fair	4	8
Poor	2	4

There were no cases of intraoperative complications. Post-operative complications included pin site infection

which was 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	12	24
Ankle stiffness	16	32
Anterior angulation	5	10
Valgus malunion	3	6

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 undertaken 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 48.5 years (Range 27 to 68 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 (72%) as compared to females

(28%). This is comparable 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 (80%) was the predominant mode of injury.

Our study had an average fracture union of 14.7 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	14.7

Functional outcome was compared on the basis of objective score of Ovadia et al[11] In our study, 20 (40%) patients had excellent outcome, 22 (44%) had good results, 5(10%) had fair outcome and 3(6%) 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 Ovardia 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	84

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

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 allowed 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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