

Outcome Assessment of Hybrid External Fixator used to Manage Compound Extra Articular Tibial Pilon Fractures

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Conflict of interest: Nil

Abstract

Aim: The aim 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 Madhubani Medical College and Hospital, Madhubani, Bihar, India for one year were included in the present study. A total of 20 patients were included in the study, based on the inclusion and exclusion criteria.

Results: 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 48.4 years. Out of 20 patients, 15 (75%) patients were males and 5 (25%) patients were females showing male preponderance because of traveling and working in fields and factories. At the end of 6 months, out of 20 patients treated, 8 (40%) patients had excellent outcome, 9 (45%) had good results, 2 (10%) had fair outcome and 1 (5%) patient had a poor result as per objective examination. On subjective evaluation, out of 20 patients treated, 9 (45%) patients had excellent outcome, 9 (45%) had good results, 1 (5%) had fair outcome and 1 (5%) patient had a poor outcome. Post-operative complications included pin site infection which were managed with culture sensitivity and appropriate antibiotics, ankle stiffness, anterior angulation and valgus malunion.

Conclusion: The study showed 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.

Keywords: Distal Tibia, Tibial Pilon, Extra Articular Fracture, Compounding, Hybrid External Fixator.

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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 to 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 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] The difficulty in treating the fractures of distal tibial end is exemplified by orthopaedists, 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 [11] Distal tibial fractures represent a significant challenge to most of the surgeons even today. They are only 1-10% of all lower extremity fractures [12]. 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 [13]. Conservative treatment by cast application lead to prolonged immobilization, leading to ankle and knee stiffness affecting quality of life of the patient. [14] 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 [15]. 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" [16]

The aim 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.

Materials and 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 Madhubani Medical College and Hospital, Madhubani, Bihar, India for one year were included in the present study. A total of 20 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.

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

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.¹⁷⁻¹⁹ 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 al²⁰ at six months and then compared with different studies.

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

Results

Table 1: Major observations of study

Criteria	Avg/most common (%)
Age of patients (year)	48.4
Sex	Male 15 (75)
Side	Left 12 (60)
Mode of injury	RTA 12 (75)
Gustillo Anderson classification	Type 11 (55)
AO/OTA classification	43-A3 9 (45)
Fixator removal	8 weeks
Fracture union	14.3 weeks

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 48.4 years. Out of 20 patients, 15 (75%) patients were males and 5 (25%) patients were females showing male preponderance because of traveling and working in fields and factories.

Table 2: Ovadia and Beals objective evaluation

Result	Patients	Percentage (%)
Excellent	8	40
Good	9	45
Fair	2	10
Poor	1	5

At the end of 6 months, out of 20 patients treated, 8 (40%) patients had excellent outcome, 9 (45%) had good results, 2 (10%) had fair outcome and 1 (5%) patient had a poor result as per objective examination.

Table 3: Ovadia and Beals subjective evaluation

Result	Patients	Percentage (%)
Excellent	9	45
Good	9	45
Fair	1	5
Poor	1	5

On subjective evaluation, out of 20 patients treated, 9 (45%) patients had excellent outcome, 9 (45%) had good results, 1 (5%) had fair outcome and 1 (5%) patient had a poor outcome.

Table 4: Post-operative complications

Complications	Patients	Percentage (%)
Pin site infection	4	20
Ankle stiffness	6	30
Anterior angulation	1	5
Valgus malunion	1	5

Post-operative complications included pin site infection which was managed with culture sensitivity and appropriate antibiotics, ankle stiffness, anterior angulation and valgus malunion.

Discussion

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. [21] Even the classifications used for the fracture didn't address the soft tissue involvement and judged severity only on the basis of fracture pattern. [22] 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. [23,24]

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 48.4 years which was comparable to that of other studies like study by Barbieri et al [25] where average age was 39 years and by Rathod et al [26] with average age of 41 years. Out of 23 patients, 15 (75%) patients were males and 5 (25%) patients were females showing male preponderance because of traveling and working in fields and factories. This is comparable to the study by Barbieri et al [25] and Ovadia et al [20] which showed male preponderance with 59% and 67% male patients.

At the end of 6 months, out of 20 patients treated, 8 (40%) patients had excellent outcome, 9 (45%) had good results, 2 (10%) had fair outcome and 1 (5%) patient had a poor result as per objective examination. On subjective evaluation, out of 20 patients treated, 9 (45%) patients had excellent outcome, 9 (45%) had good results, 1 (5%) had fair outcome and 1 (5%) patient had a poor outcome. Post-operative complications included pin site infection which were managed with culture sensitivity and appropriate antibiotics, ankle stiffness, anterior angulation and valgus malunion. Aggarwal et al [27] 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 [28] 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%).

Conclusion

The study showed 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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