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A prospective and retrospective study for definitive management of fracture tibial condyle with compromised skin with hybrid fixator

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Abstract

Introduction: Proximal tibial fractures present a broad spectrum of soft tissue and bony injury patterns. Fractures of the proximal tibia are caused by high-energy mechanisms, a careful evaluation of the entire patient must be done. 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 cancellous fragment, whereas the pin fixators give adequate stability to the diaphyseal fragment. It also allows immediate mobilization of the joints and early weight bearing.

Materials and methods: This study was conducted on 60 patients after satisfying inclusion criteria with fracture tibial condyle with compromised skin definitively managed with a hybrid fixator.

Results: The present study consists of 60 cases of proximal metaphyseal fracture of the tibia. 2 patients were lost to follow up and not included in the analysis. In all cases, fractures were fixed using the hybrid fixator. The proximal tibia fracture united with an average of 15.2 weeks (range 13-18weeks). There were one case of delayed union, which united with PRP (platelets rich plasma). There were 2 nonunion, which was again operated with proximal tibia locking plate and united. 2 cases lost from follow-up. The fracture of the proximal tibia united with an average of 15.2 weeks (range 13-18weeks). There were one cases of delayed union, which united with PRP (platelets rich plasma). There were 2 nonunion, which was again operated with proximal tibia locking plate and united.

Conclusion: 60 patients with fractures of the proximal tibial periarticular fracture, all patients were operated on within 7 days had undergone closed reduction and application of the hybrid external fixator. This method limits further damage to the already compromised soft tissue. Its greatest advantage is in open fractures, where wounds can be left open. It is also effective in extra articular fractures occurring within 5cm of the joint. When encountered with the reconstruct able tibial metaphyseal fracture, those with comminution or poor bone stock, closed reduction and Hybrid External Fixator satisfies the goals of fracture union and soft tissue healing.

Keywords: tibial condyle fractures, hybrid fixator, skin condition, Gustilo Anderson classification, Rasmussen's functional knee score, PRP, infection, malunion

1. Introduction

Intra-articular and extra-articular fractures of the proximal tibia present a wide spectrum of soft tissue and bony injury patterns that can produce permanent impairments. For patients treated operatively the residual disabilities are not only attributable to the severity of the injury, but also to the complications and side effects of the operative intervention. Because many fractures of the proximal tibia are caused by high-energy mechanisms, a careful evaluation of the entire patient must be done before the tibial injury is addressed. Open fractures, fractures accompanying a compartment syndrome and fractures associated with vascular compromise usually require immediate intervention ^[1]. 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 cancellous fragment, whereas the pin fixators give adequate stability to the diaphyseal 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 ^[2]. Along with rigid fixation, it allows immediate mobilization of the joints and early weight bearing "Early motion has been touted as the functional savior of major intra articular injuries" ^[3].

Tibial plateau fractures are one of the commonest intra-articular fractures. They result from indirect coronal or direct axial compressive forces. They comprise of 1% of all fracture [4]. These fractures encompass many and varied fracture configurations that involve medial, lateral or both plateaus with many degrees of articular depressions and displacements. It is essential to determine the force of injury since high-energy trauma is associated with considerable soft tissue and neurovascular damage. Apart from tibial plateau bony injury, meniscal tear and ligament injuries should also be assessed [5].

Material and Methods

This study was conducted on 60 patients with fracture tibial condyle with compromised skin definitive management with a hybrid fixator in the Department of Orthopaedics at Dr. S. N. Medical College Associated Hospital, Jodhpur. The study was done after approval by the ethical committee both retrospective and prospective from December 2019 to November 2021. Patients with fractures proximal tibia both intraarticular and extra articular with compromised skin. Patient aged more than 18 years. Proximal tibia fractures unsuitable for interlocking nailing and other procedure were included and Patients aged below 18 year. Patient with the comorbid condition and not fit for surgery and non-complaint were excluded.

On admission 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 patterns 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.

The following protocol was followed once patient were admitted and planned for surgery.

The fracture was stabilized with plaster of paris slab immobilization and limb elevation was given.

All patients were operated on within 7 days after injury.

All the patients were explained and motivated about the cosmetic problems and difficulties in daily routines by the application of an external fixator.

Patients were stabilized hemodynamically and physical fitness for surgery was obtained.

Preoperative planning done for hybrid external fixator.

Appropriate and valid written consent were taken.

The patient was taken for surgery after routine investigations and after obtaining fitness toward surgery.

A dose of tetanus toxoid and antibiotic were given pre-operatively.

Instruments were checked and sterilized beforehand.

Procedure

- Under anaesthesia patient was put in a supine position on a fracture table except for few cases where the elevation of the depressed fragment was necessary.
- Parts were scrubbed, painted and draped.
- The fracture was reduced by traction and manipulation under image intensifier guidance.
- By maintaining reduction, Ilizarov wires passed into tibial plateau.
- Attach wire to ring using adjustable wire /pin clamp.
- Tightens clamp locking nuts of wire with a spanner.
- Wrench tighten the wire locking nuts on the far side of the ring. Apply clamp on the side to be tensioned.
- The free side of the wire were tensioned with a tensioner upto 100kg. Tighten wire locking nuts and remove the

tensioner, to obtain maximum tension, it is recommended after tensioning the second wire, to retension both wire in the same sequence to obtain the best from stability, or an alternative method would be to use two tensioner simultaneously.

- Insert schanz screw in to proximal fragment –insert through wire/pin clamp.
- Note –a third wire be inserted if the frame pattern does not permit schanz screw placement.
- Trim bend and cut wires leaving 3cm-4cm, in case retensioning becomes necessary.
- Insert schanz screw in to distal fragment.
- Connect ring to the half frame with a ring to rod clamp.
- Reduce extraarticular component of fracture tighten the ring to rod clamp.
- Add a second rod-connect ring to rod clamp combination.
- Finally, skin suturing if any than apply dressing.
- Patients were followed up at 2 weeks than 6 weekly intervals until fracture union and at once at the end of 1 year. The fracture were said to be united when there were a sign of union at the fracture site at least in three cortices in the anteroposterior and lateral views. Trabeculations extending across the fracture site were also taken into consideration.
- The scoring system used in this study was the Rasmussen's functional knee score according to the location of the fracture.

Observations and results

The present study consists of 60 cases of proximal metaphyseal fracture of the tibia. 2 patients were lost to follow-up and not included in the analysis. In all cases, fractures were fixed using the hybrid fixator. The study was conducted from December 16 to November 19. The age of the patients ranged from 20-70 years with the fracture being most common in the 4th decade and a mean age of 39.2 years, Out of 60 patients, 57(95%) patients were males and 3 (5%) patients were females showing male preponderance because of traveling and working in field and factories. Out of the 60 cases, 32 (53%) cases were closed fracture and 28 (47%) cases were open fractures.

Out of the 28 cases of open fractures 20 (91%) were type II, 4(14%) were of type IIIA and 4(14%) were type IIIB of Gustilo Anderson classification, out of the 32 cases of closed fractures, 3(9%) patients had C1 injury, 28 (87%) had C2 injury and 1(3%) had C3 injury of Tscherne classification of Soft tissue injuries in closed fractures, The fracture were classified based on AO/OTA classification for fracture of the proximal tibia of total 60 cases studied, 2(3%) cases were A2, 2(3%) were A3, 4(7%) were B1, 13(22%), 19(32%) were B3, 13(22%) were C1, 6(10%) were C2, and 1(2%) case was C3 type of fracture. 55 (91%) of the patients sustained the injury following a road traffic accident and 5(9%) patients sustained injury following a fall. Out of which 2 fall at home on floor and 3 fall from height.

Out of 60 cases there 2 cases had a head injury which was managed conservatively. 2 cases had fracture distal end radius from them 1 managed conservatively with close reduction and below elbow cast and 1 case managed with Jess fixator. 2 cases had fracture shaft of radius which manage with fore arm plating. 1 case had fracture acetabulum, which manage conservatively. 2 cases had fracture 2nd and 3rd metacarpal managed with close reduction and fixation with k-wire.

The fracture of the proximal tibia united with an average of 15.2 weeks (range 13-18 weeks). There were one cases of

delayed union, which united with PRP (platelets rich plasma). There were 2 nonunion, which was again operated with proximal tibia locking plate and united. 2 cases were lost from follow-up. The fracture of the proximal tibia united with an average of 15.2 weeks (range 13-18weeks). There were one cases of delayed union, which united with PRP (platelets rich plasma). There were 2 nonunion, which was again operated with proximal tibia locking plate and united. 2 cases lost from follow-up.

The average duration of removal of fixator is 18.2 weeks and after removal of fixator applies PTB cast for 3 weeks, there were no intraoperative complications.

Post-operative complication

Pin track infection: 5(9%) patients developed pin track infection, which were treated with daily dressing and appropriate antibiotic after pus culture and sensitivity. All these infections subsided on the above said treatment. Malunion: 2 cases had valgus malunion (4%). Nonunion: 2 cases had nonunion (4%), which was treated with a proximal tibia locking plate. 1 case had delayed union, which was treated with platelet rich plasma injections. 1 case had foot drop, which manage conservatively and recovered after 4 months.

The result were based on the objective and subjective parameters as described by Rassmussen's functional knee scoring system for proximal tibia fracture.

In which a score of 28-30 points was considered excellent; 24-27 points good; 20-23 points fair; < 20 points considered as poor outcome.

Excellent outcome in 56.90% (33) patients, good outcome in 34.84% (20) patients and poor outcome in only 1.72% (1) patient as per Rassmussen's functional knee scoring system in our study.



Fig 1: Proximal tibia (pre op)



Fig 2: Follow up after 6 month



Fig 3: Follow up after 2 month



Fig 4: Follow up after 6 month



Fig 5: Immediate post OP



Fig 6: Post op X-rays after 2 month

Discussion

Fractures of the proximal tibia (periarticular) are the most difficult fractures to treat effectively because of the soft tissues injuries, the degree of comminution and articular damage sustained at the time of injury affect the long term clinical results.

The goal of operative treatment is to obtain intraarticular reduction while providing enough stability to allow early motion. This should be accomplished using techniques that minimize osseous and soft tissue devascularization in the hopes of decreasing the complications resulting from treatment.

The present study was under taken to determine the efficacy of the Hybrid External Fixator as a definitive management in treating of the fractures of the proximal tibia. We evaluated our results and compared them with those obtained by various other studies. In our study, the average age of patients with such injuries to be 39.2 years, (range 22 to 70 years) which is comparable to that of other studies.

In Guadinez *et al.* [8] study mean age was 47 years (range from 23 to 73 years). In Kumar *et al.* study mean age was 44 years (range from 14 to 76 years). In our study, the male preponderance for such kind of injuries were high at 95% compared to the study of Zeman, J Metejka J [6], which was 76% possibly due to the fact of male dominance over the female in traveling, occupational injuries etc., in India. However, the study by Kumar *et al.* [9] were comparable in the fact that they had 72% male: Guadinez *et al.* [5] observed 93% high energy fracture in his study. Aseri *et al.* [7] observed in their study that 74% fractures were high energy trauma. However in our study 96% of fractures were due to high energy (RTA & fall from height) and 4% of fractures were due to low energy trauma (fall at home).

Comparison of Results

Zeman *et al.* [6] in their study of periarticular fractures of the tibia treated with hybrid external fixators obtained 5 excellent (26%), 6 very good (32%), 5 satisfactory (26%) and 3 poor results (16%).

Aggarwal *et al.* [10] 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%).

Stannard *et al.* [11] studied 34 tibial plateau fractures treated by Less invasive stabilization system. All of the fractures healed without additional surgical intervention or bone grafting. The average time to radiographic callus was 6.1 weeks, and the average time to complete union was 15.6 weeks. The articular step-off average was 0.8 mm, with a range of 0 to 5 mm. The postoperative alignment demonstrated 2 patients (6%) with a malunion. There were 2(6%) superficial wound infections and no cases of deep infection or osteomyelitis.

Cole *et al.* [12] in their study of fractures of the proximal tibia treated with the Less invasive stabilization system, showed 70(91%) of 77 fractures healed without any major complications. There were 2(2.6%) early losses of proximal fixation, 2(2.6%) nonunion, 2(2.6%) deep delayed infections, and 1(1.3%) deep peroneal nerve palsy. Other complications included a superficial wound infection. Postoperative mal alignment occurred in 7(9%) patients. In 4(5%) patients, the hardware was removed at an average of 13 weeks because of irritation. The mean time for allowance of full weight-bearing was 12.6 weeks (range: 6-21 weeks).

Stamer *et al.* [13] studied 22 patients with Schatzker type VI tibial plateau fractures were treated with a hybrid ring

external fixator. 8 patients were treated with limited open reduction and internal fixation before application of the frame. 14 patients had percutaneous cannulated screw fixation to stabilize the articular surface without opening the fracture site. The average time of healing was 4.4 months. 4(18%) flexion contractures of 5-15 degrees. 3(14%) patients had deep wound infections, 1 (5%) patient developed deep venous thrombosis, 1(5%) patient went into malunion, and 1(5%) Pin tract infection. There were 13(59%) excellent, 3(13%) good, 1(5%) fair, and 6 (23%) poor results.

In the present study, there were 60 proximal tibia periarticular fractures managed by hybrid external fixators. All the fractures united at an average of 15.2 weeks. There were 33 (57%) excellent, 20(35%) good and 4(7%) fair and 1(2%) case poor results. There were 5(9%) cases of pin tract infection, 1 (2%) case of delayed union, which was managed by platelet rich plasma injection, 1 case of non-union (2%), which was managed by proximal tibia locking plate and 2 cases of wire breakage (4.5%). Pin tract infection resolved in all patients with regular dressings.

Summary

In our study 60 cases of fracture proximal tibia with compromised skin and soft tissue were treated with the hybrid external fixator as a definitive management. The follow up ranged from 6-12 months.

The average age of the affected patients was 39.2 years. Most of the fractures were closed. A significant number of fractures belonged to the B3 (AO/OTA) type, Males were predominant. Majority of fractures were due to Road Traffic Accidents.

The average duration of surgery was 89 minutes and all fractures united in an average of 15.2 weeks. Fixator was removed 3 weeks after fracture union all cases with the exception of 2 cases those lost follow up.

The results showed 33 (57%) patients with excellent results, 20 (35%) with good results, 4 (7%) and 1 (2%) patients had a poor result by using Rasmussen's functional knee scoring system.

The fair results were mainly due to the knee or ankle stiffness and delayed union. We do not believe stiffness was related to the method of fixation, but due to the patient in compliance to the physiotherapy regimen.

Conclusion

According to the present study, 60 patients with fractures of the proximal tibial periarticular fracture, all patients were operated on within 7 days had undergone closed reduction and application of the hybrid external fixator. This technique has resulted in the effective stabilization of these fractures. It provides adequate stability and allowed early motion. The closed reduction not only helps in achieving a reduction in difficult situations, but also in the rapid union, because it facilitates the preservation of blood supply to the fragment. This method limits further damage to the already compromised soft tissue. Its greatest advantage is in open fractures, where wounds can be left open. It is also effective in extra articular fractures occurring within 5cm of the joint because, intramedullary nails often do not provide enough stability and plates would require extensive soft tissue dissection. It is a simple, has a rapid and straight forward application and has a reduced surgical time. Tensioned wires provided fixation in small and osteoporotic fragments.

When encountered with the reconstructable tibial metaphyseal fracture, those with comminution or poor bone stock, closed reduction and Hybrid External Fixator satisfies the goals of

fracture union and soft tissue healing, without obviating any other means of further treatment.

Although, a larger sample of patients and longer follow up are required to fully evaluate this treatment method, we strongly encourage its consideration in the treatment of such complex fractures.

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