

Management of Tibial Metaphyseal Fractures Using JESS Fixator.

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Abstract

Introduction: The management of proximal and distal tibia fractures remains challenging due to associated soft tissue injuries. The use of wire fixators for the definitive treatment of such fractures entails a minimally invasive technique of insertion that gives good fracture reduction and stability combined with minimal postoperative complications.

Aim: To assess the outcome of treatment of such fractures by the use of Joshi's external stabilization system (JESS), which is a simple wire based, circular external fixator system.

Materials and Methods: A prospective, uncontrolled study was done using JESS on 30 consecutive patients (20 patients of proximal tibial metaphyseal fractures and 10 of distal tibial metaphyseal fractures).

Results: In our study, the most common mode of injury was road traffic accidents (21 cases), fall from height (6 cases) and slip injury (3 cases). The patients were operated at a mean interval of 3.2 days (range 1-6 days) due to associated poor soft tissue conditions. The patients were followed up for 24 weeks. Full weight bearing was allowed at 10 to 14 weeks. JESS frame was removed at mean duration of 13 weeks (range 12-16 weeks). According to knee society score (KSS), excellent result (score 80-100) was seen in 12 patients (60%), good result (score 70-79) was seen in 4 patients (20%), fair result (score 60-69) in 3 patients (15%) and poor result (score <60) in 1 patient (5%) of proximal tibial metaphyseal fracture. According to Olerud and Molander score (OAMS), excellent result (score 91-100) was seen in 5 patients (50%), good result (score 61-90) in 3 patients (30%) and fair result (score 31-60) in 2 patients (20%) of distal tibial metaphyseal fracture. The complication seen was superficial pin tract infection in 4 patients, which was managed by regular pin tract dressing and oral antibiotics. Delayed union (mean at 15.3 weeks) was seen in 2 patients with Schatzker type VI fracture and 1 patient with severe comminuted distal metaphyseal fracture.

Conclusion: JESS is a simple, light, effective and cheap method and can be used as a definitive procedure to treat these fractures even with soft tissue compromise.

Keywords: Tibial plateau, Tibial pilon/plafond, JESS

Introduction

Tibial plateau fractures results from indirect coronal and/or direct axial compressive forces combined with some varus and valgus forces. Motor-vehicle accidents and falls are the most common mode of injury [1]. Tibial pilon or plafond fractures are caused by axial loading in which talus is driven into the distal tibia, exploding the distal tibial articular surface with impaction of the metaphyseal bone [2]. The management of tibial plateau and tibial pilon fractures remains challenging due to associated soft tissue injuries. Tibial plateau fractures are widely classified by Schatzker

classification system into six grades, out of which grade V (bicondylar) and grade VI (plateau fracture with dissociation of metaphysis from diaphysis) are the most severe injury patterns, associated with high incidence of complications [3]. Tibial pilon fractures are mostly classified by Ruedi and Allgower system into three types, type III demonstrates severe comminution of distal tibial articular surfaces [4]. Distal tibial fractures are prone to nonunion because of less musculature, subcutaneous location of the bone and poor vascularity [5].

The goal of treatment in such fractures is the anatomical restoration of articular surface congruity, prevention of post traumatic degenerative joint disease, healing of soft tissue cover and early joint mobilization to prevent joint stiffness. There are different modalities to treat such fractures like joint spanning external fixator, illizarov or hybrid external fixator, ORIF/ LISS with plates & screws and Joshi's external stabilization system (JESS).

Joint spanning external fixator is applied as a temporary device to allow soft tissue to settle down, requires second definitive procedure to address the fractures [6,7].

Illizarov or hybrid external fixator can be applied as definitive procedure to treat such fractures but frames are usually bulky and requires expertise [8-10].

ORIF/ LISS with plates and screws is a gold standard treatment for these fractures to achieve a precise anatomic reduction of joint surface but it is associated with complications especially with compromised soft tissue envelope and bulky metallic hardware [11-15].

JESS is a good alternative technique in the management of these complex fractures. It is a wire based external fixator system that can be used as a definitive treatment of such fractures that allows soft tissue care and early mobilization of joints to prevent joint stiffness.

In this study, our aim is to assess the functional outcome of treatment of such fractures by the use of JESS.

Materials and Methods

The hospital based, prospective, randomized study was done on 30 patients of tibial metaphyseal fractures admitted at Janakpur trauma hospital, between 2016 to 2020.

Out of 30 patients, 20 patients were of proximal tibial metaphyseal fractures (15 patients with intra-articular extension and 5 patients of extra-articular proximal metaphyseal fractures). Among proximal tibial metaphyseal fracture with intra-articular extension, the study includes Schatzker type V (bicondylar fracture) and type VI (plateau fracture with dissociation of metaphysis from diaphysis).

The other 10 patients were of distal metaphyseal fractures (7 patients with intra-articular extension and 3 patients of extra-articular distal metaphyseal fractures).

On admission, the limb of the patients was splinted and advised for elevation of leg. The soft tissue condition of the limbs was observed regularly. The compound fractures were thoroughly irrigated with normal saline, covered with sterile dressing and splinted. Prophylactic antibiotics (third-generation cephalosporin, ceftriaxone) was given to patients with compound fractures. X-rays of the fractured limb with knee and ankle joints were taken in two planes, antero-posterior and lateral views. 3D CT scan was done in cases with gross comminution. Patients were operated as early as possible once the swelling of the soft tissue cover start showing reversing trend and general condition of the patient was stable and fit for surgery. Routine investigations were done and pre-an-

aesthetic clearance was taken. A well-informed consent was taken from patient/guardian.

Surgical Technique

Patients were operated under spinal or general anesthesia as decided by anesthetist. The patient was placed supine on radiolucent table. Tourniquet was not used for the surgery. The fracture was reduced by giving traction ligamentotaxis under image intensifier guidance and pointed reduction clamp was used to compress the fracture fragments [16]. In cases where condyles were widely separated, partially threaded cannulated cancellous screw (6.5mm) was used either one or two in number, to engage the major condylar fragments in a lag fashion to restore the articular surface. One 2.5 mm k-wire was passed 5 to 10 mm distal to articular surface in proximal metaphyseal fracture (proximal to articular surface in distal metaphyseal fracture) from postero-lateral aspect of tibia to exit on antero-medial aspect. Second 2.5mm K-wire was passed from postero-medial aspect of tibia to exit on antero-lateral aspect. Third 2.5mm k-wire was passed inbetween the two previous k-wires at the same level. These k-wires were fixed to one or two half-circle rings with link joints. Then two or three 2.5mm k-wires were inserted through safe zones in the tibial shaft from lateral aspect to exit on the medial side. The metaphyseal hold (half-circle rings) was then connected to the diaphyseal hold by giving traction to reduce the metaphyseal fragments by ligamentotaxis. The assembly was then completed by adding straight, 'Z' or 'L' connecting rods and link joints, after checking the reduction as well as alignment under image intensifier (Figure 1).

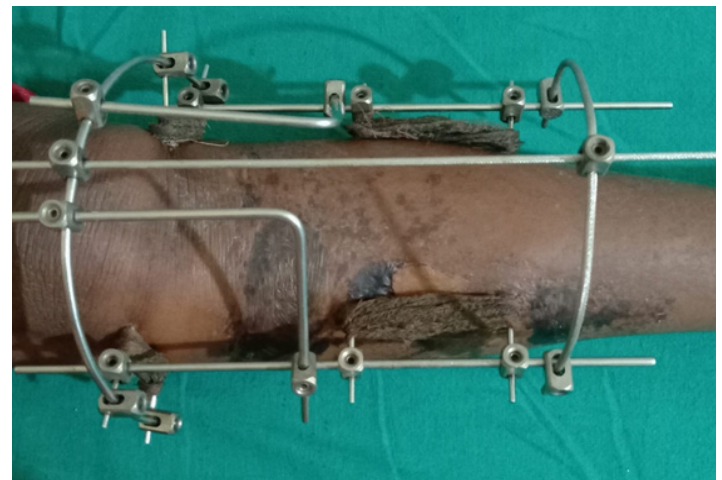


Figure 1: Showing components of JESS assembly.

Postoperative period and follow-up:

Quadriceps strengthening exercises and range of motion exercises for knee & ankle was started from first postoperative day. Pin tract dressing was done daily with povidone iodine. Non-weight bearing mobilization was started from 2nd or 3rd postoperative day depending on patient comfort. Patients were followed-up at 6, 12, 18 & 24 weeks postoperatively. During each visit x-rays were done to look for radiological union and patients were assessed for clinical union.

At 6 weeks, depending upon radiological and clinical union partial weight bearing was started and gradually increased as tolerated.

JESS frame was removed once patient started walking comfortably with frame insitu, usually around 12-16 weeks postoperatively.

The functional outcome was assessed using knee society score (KSS) for proximal tibial metaphyseal fracture & Olerud and Molander score (OAMS) for distal tibial metaphyseal fracture at the end of 6 months following surgery [17-19].

Results

In our study, out of 30 patients (20 patients of proximal metaphyseal fracture and 10 patients of distal metaphyseal fracture), 17 patients (56.66%) were male and 13 patients (43.33%) were female. The mean age of patient was 32.1 years (range 20-65 years). The most common mode of injury in our study was road traffic accidents (21 cases), fall from height (6 cases) and slip injury (3 cases). Out of 20 patients of proximal tibial metaphyseal fracture (15 patients with intraarticular extension and 5 patients of extraarticular metaphyseal fracture), 11 patients had associated soft tissue complications in the form of massive swelling, bruises and blisters formation, 4 patients had compound fractures (two Gustilo type II and two Gustilo type IIIA). Among 15 patients with intraarticular extension, 9 were of Schatzker type V and 6 were of Schatzker type VI. One patient had compartment syndrome, for which fasciotomy was done.

Among 10 patients of distal metaphyseal fracture (7 patients with intraarticular extension and 3 patients of extraarticular distal metaphyseal fracture), 5 patients had poor skin conditions and 2 patients had compound fractures (Gustilo type II).

Patients were operated at a mean interval of 3.2 days (range 1-6 days). The delay in surgery was due to poor skin conditions. In 6 patients with tibial plateau fracture, CCS (6.5mm) were used in a lag fashion to restore the articular surface. The patients were followed up for 24 weeks. Full weight bearing was allowed in most of the patients at 10 to 14 weeks. JESS frame was removed at mean duration of 13 weeks (range 12-16 weeks). The functional outcome was assessed using knee society score (KSS) for proximal tibial metaphyseal fracture & Olerud and Molander score (OAMS) for distal tibial metaphyseal fracture. According to KSS, excellent result (score 80-100) was seen in 12 patients (60%), good result (score 70-79) was seen in 4 patients (20%), fair result (score 60-69) in 3 patients (15%) and poor result (score <60) in 1 patient (5%) of proximal tibial metaphyseal fracture. (Figure 2 and Figure 3).

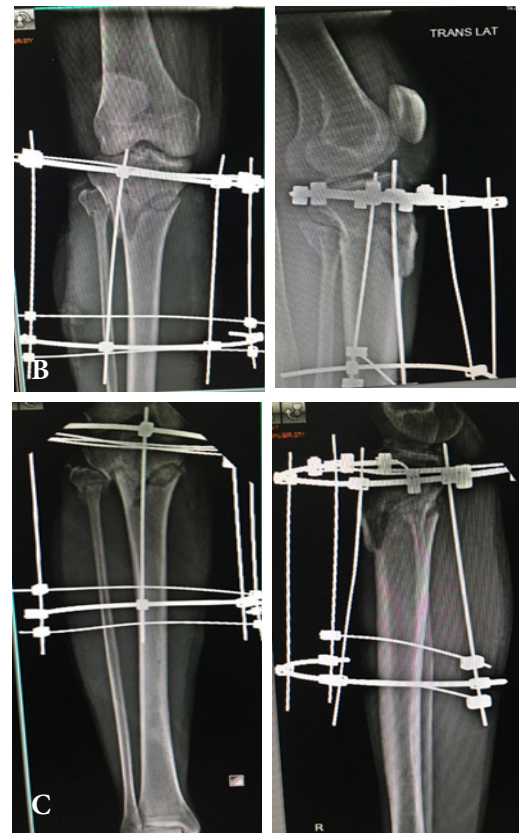


Figure 2: A: Preoperative x-ray of a patient with tibial plateau fracture. B: Postoperative x-ray after application of JESS. C: Follow-up x-ray at 6 weeks. D-F: Clinical picture after removal of JESS at 12 weeks.

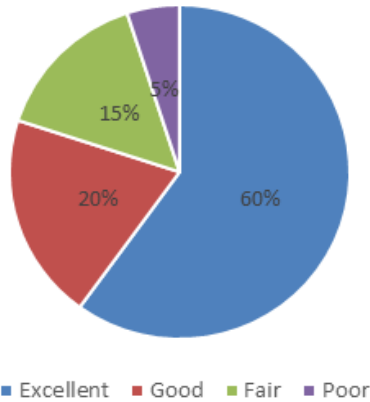


Figure 3: Pie Chart showing functional results of proximal tibial metaphyseal fractures in accordance to Knee society score (KSS).

According to OAMS, excellent result (score 91-100) was seen in 5 patients (50%), good result (score 61-90) in 3 patients (30%) and fair result (score 31-60) in 2 patients (20%) of distal tibial metaphyseal fracture. (Figure 4 and 5).



Figure 4: A: Preoperative x-ray of a patient with distal tibial metaphyseal fracture. B: Postoperative x-ray after application of JESS. C: Follow-up x-ray at 6 weeks. D: Follow-up x-ray after removal of JESS at 12 weeks. E-G: Clinical picture after removal of JESS.



Figure 5: Pie Chart showing functional results of distal tibial metaphyseal fractures in accordance to Olerud and Molander score (OAMS).

The mean range of motion of knee was 110° (range 90°-125°) at 24 weeks, while mean planter flexion of ankle was 10° (range 7°-15°) and mean dorsiflexion was 8° (range 5°-10°). The complication seen was superficial pin tract infection in 4 patients, which was managed by regular pin tract dressing and oral antibiotics. Delayed union (mean at 15.3 weeks) was seen in 2 patients with Schatzker type VI fracture and 1 patient with severe comminuted distal metaphyseal fracture.

Discussion

The management of proximal and distal tibial fractures pose a great challenge due to associated soft tissue injuries. The conventional method of treatment by ORIF with plates and screws are often associated with complications like necrosis of soft tissue, problems in wound healing, exposure of metallic hardware and high rate of infection. The advent of minimally invasive techniques of internal fixation could not solve this challenge completely. In this situation the treatment of these fractures by external fixators either in the form of illizarov or hybrid external fixator or JESS has shown the promising results. Illizarov or hybrid external fixator is technically demanding, requires expertise and the frames are usually bulky. JESS has evolved as an attractive option in the treatment of these fractures. The biggest advantage of JESS is the ability to reduce and stabilize the fracture with minimal or no soft tissue dissection in an already compromised soft tissue environment.

Subramanyam KN et al., in their study of 30 patients with complex tibial plateau fractures treated with illizarov external fixator with or without minimal internal fixation, found excellent results in 16 patients (53.3%), good in 8 patients (26.6%), fair in 5 patients (16.6%) and poor in 1 patient (3.3%) [20]. Catagni MA et al., in their study of 59 patients of complex tibial plateau fractures treated with external circular fixation and limited internal fixation, reported excellent results in 30 patients (50.8%), good in 27 patients (45.7%), fair in 1 patient (1.6%) and poor result in 1 patient (1.6%), while 23.7% patients develop pin site infections, which were superficial that resolved with local pin site care and oral antibiotics [21]. Scaglione M et al., in their series of 75 patients of tibial pilon fractures treated with hybrid external fixator, reported 44% excellent, 40% good, 7% discrete and 9% bad results. 30% patients developed superficial infection of pin site, which resolved with oral antibiotics [22]. Singh H et al. in their study of 20 patients of proximal tibia fractures managed with JESS, reported excellent results in 12 patients (60%), good results in 6 patients (25%), fair in 2 patients (10%) and bad in 1 patient (5%). 2 cases (10%) developed pin tract infections which resolved with dressing and oral antibiotics; while 1 case (5%) had non-union in which tibial plateau fracture extended into proximal 1/3rd of the tibial shaft with severe comminution [23]. Ibrahim M et al., in their series of 12 patients of compound distal tibia fractures treated with JESS, reported excellent result in 10 patients (83%), fair result in 1 patient (8.3%) and poor result in 1 patient (8.3%). One patient had non-union and one patient developed infection which subsequently united with bone grafting and oral antibiotic respectively [24].

The results in our study are comparable with above studies in which either Illizarov or hybrid external fixator or JESS are used to treat these fractures.

Conclusion

JESS is an alternative technique to treat such types of fractures. It is simple, light, effective and cheap method and can be used as a definitive procedure to treat these fractures even with soft tissue compromise.

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