

Evaluation of Role of Hybrid Fixator in Complex Proximal Tibial Fractures. A review of thirty five cases

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Abstract:

Background: Proximal tibial fractures present a difficult problem both in relation to bony as well as soft tissue. These injuries are further complexed by open fractures thereby decreasing the success of any treatment method.

Methods: We retrospectively analyzed 35 cases of AO/OTA Type 41C2 and 41C3 proximal tibial fractures treated with either closed reduction or minimal open reduction and stabilization hybrid fixator. Twenty-one cases were closed fractures while fourteen cases were open injuries. Minimum duration of follow-up was six months and maximum was Three years.

Results: We assessed our results using Rasmussen Scoring system and found 86% acceptable result. Average range of motion achieved is 110 degree. Most common complication was Pin tract infection in 14(40%) cases, three patients had peroneal nerve palsy recovered completely with average time of 14 weeks, Malunion was seen in two cases (6%) and there was no nonunion.

Conclusion: Comparing the results with the previously reported study, our series support the use of hybrid external fixator in complex proximal tibial fractures with minimal complications both in relation to bone as well as soft tissue.

I. Introduction

The fractures that involve the proximal tibia affect knee function and stability [1]. Proximal tibial fractures involving the articular surface are serious, complex injuries difficult to treat as they entail problems like articular depression, condylar displacement, and dissociation of comminuted metaphysis from diaphysis and open wounds or extensive degloving injuries [2]. Exact diagnosis, adequate treatment and optimal rehabilitation are necessary to achieve good long-term results otherwise they are associated with post-operative functional limitations in a large percentage of patients.

It is essential to determine the amount of trauma since high-energy trauma is associated with considerable soft tissue and neurovascular damage. Apart from tibial plateau bony injury, meniscal tear & ligament injuries should also be assessed.

Varied classifications system has been devised to classify proximal tibial fractures such as Hohl's, Moore's, Schatzker and the AO/OTA classification. We used AO/OTA classification to standardize our study [3]. These fractures have tendency of high rate of complications, such as wound problems, infections, varus collapse, knee stiffness, ligament injury and articular malreduction. Early detection and appropriate treatment of these fractures are critical in minimizing patient disability and reducing the risk of documented complications, particularly arthritis [4].

The treatment modalities ranging from skeletal traction to complex demanding surgeries are described in the literature. Different modalities had their share of success and failure. With the advent of newer generation locked plates the results of internal fixation has shown improvement in the past decade, but still planning a internal fixation in compromised skin conditions could spell disaster. The recent advances in hybrid fixator and there use in proximal tibial fractures has shown promising results [5]. The aim of surgical treatment of proximal tibia fractures is to restore and preserve normal knee function, to re-establish joint stability, alignment and articular congruity while preserving full range of motion so that painless knee function may be achieved and posttraumatic arthritis may be prevented. The purpose of this study was to assess the role of hybrid fixator with or without minimal invasive technique in complex proximal tibial fractures, and to compare our results and complications with previous studies.

II. Material And Methods

After receiving approval from Institutional Review Board, we retrospectively assessed our series of 35 patients admitted in our institute, operated and followed for minimum of six months and maximum of three years during September 2011 to September 2014. Inclusion criteria were Bicondylar tibial plateau fractures AO/OTA Type 41C2 and 41C3, in skeletally mature patient, community ambulatory without support and with

opposite normal limb. Polytrauma patients requiring prolonged ICU stay, patients associated with vascular injuries, Pathological fractures, Compound fractures grade III C, previous fracture in opposite lower limb, bilateral tibial plateau fracture, were excluded from the study. All patients were treated with either closed reduction and hybrid external fixation or with minimally invasive reduction of articular fragments and application of hybrid external fixator.

Of 35 patients operated 23 were males and 12 were females with average age for males was 37.5 years (range 21-66) and for females 42.5 years (range 29- 72). In 27 patients the mechanism of was road traffic accident while in rest of 18 cases the cause was fall from significant height. All patients were given above knee POP slab in emergency and had antero-posterior, lateral and oblique radiographs of both affected and un affected side. All patient had 3D reconstruction CT to better assess the fracture geometry.

The radiographs and CT were used to classify the fractures according to AO/OTA classification. There were 25 type 41C2 and 10 41C3 fractures. Of all the fractures 21 were closed and 14 were open fractures (10 were Gustilo Anderson type IIIA and 4 were type IIIB). Neurovascular status was assessed in the emergency department and 3 patients were found to have peroneal nerve injury and all were open IIIB fractures. Twenty patients were subjected to minimal open reduction to achieve articular congruity with cannulated cancellous screws and application of external hybrid fixator, rest fifteen were closely reduced and stabilized with external hybrid fixator. All patients were available for follow-up with minimum follow-up of 6 months and maximum of 3 years. All patients underwent radiographs at 6 weeks, 12 weeks, 18 weeks, 6 months and then yearly.

Timing of surgery was determined by the soft tissue conditions, all the open fractures were operated immediately after initial resuscitation, with thorough toileting, debridement and intravenous antibiotics. Of the remaining twenty-one patients eleven were operated within one day while ten were operated with an average delay of 7 days (range from 5 to 10 days). The delay was determined by the soft tissue envelope of the proximal tibia to allow for swelling to subside.

Surgical Technique

All patients were operated under regional anaesthesia with patient positioned on radiolucent table with knee in 30 degrees of flexion. Preoperatively a single dose of Third Generation cephalosporin is given in all cases. Closed reduction is done using femoral distractor and checked under image intensifier, and was found to be acceptable in fifteen cases. Minimal open reduction was done in all the open fracture and six closed fractures. A small window is created in the antero medial or anterolateral aspect depending upon the fracture geometry, and small blunt periosteum elevator is inserted to lift the fracture fragments, the resultant gap is filled with autologous bone graft. The fracture fragments are held with multiple k wires and stabilized with one or two cannulated cancellous screws inserted over them. After achieving reduction whether open or closed the hybrid external fixator was applied. The ring of the fixator was positioned at the level of fibular head. We routinely used two olive wires first one from posterolateral aspect of tibia, one fingerbreadth anterior to fibular head directed anteromedially towards just medial to medial aspect of patellar tendon and second wire from posteromedial border of tibia directed anterolaterally to just lateral to the lateral border of patellar tendon, position checked under image intensifier. The 5/8th ring of appropriate size was attached to the olive wires keeping two-finger breadths distance on all aspects, and tension was applied of up to 1400 N and wire were locked under tension. The uniplanar fixator is applied over the anteromedial aspect of tibia and both the constructs were attached to each other and reduction is checked under image intensifier. The open wounds were left open for delayed primary closure or secondary closure.

Postoperatively importance was given to pin tracts and knee range of motion exercises that were started after 24 hours of operation as tolerated by patient.

All patients were discharged were between 5th to 14th day post operative day depending upon the wound conditions. All patients were followed in the outpatients department with radiographs performed on 6 weeks; 12 weeks, 18 weeks and pin tract were watched for any evidence of infection. Patients were encouraged to perform vigorous range of motion exercises. Weight bearing gradually encouraged from 8th week onward depending upon the fracture union. Hybrid fixator was removed at an average of 16 weeks post surgery.

III. Results

Radiographic assessment was done for fracture union, condylar depression, condylar widening, valgus and varus angulation. Clinical assessment was done for subjective complaints, range of motion, stability of knee and other associated complications. Final results were assessed as per Rasmussen scoring system after union. The results were graded as excellent in 21(60%), good in 9(25%), and fair in 5 cases(15%).

Of 14 open fractures, four Gustilo Anderson IIIB were AO/OTA 41C3 and six 41C3 were Grade IIIa, Four 41C2 were grade IIIa. These fractures reported with the complication seen in our study. The most common complication was Pin tract infection seen in 14 patients(40%) all were open fractures, it was treated with oral antibiotics and pin site dressing, all healed with no evidence of deep infection. Wound complication were seen

in all the four grade IIIb AO/OTA 41C3 requiring second repeat toileting and debridement on second to fourth post operative day. All wounds were either closed primarily (10,72%) after second debridement or allowed to heal by secondary intention with or without local flap coverage(4,28%). Two patients required local musculocutaneous flap requiring the help of plastic surgeons. Malunion was seen in two patients valgus angulation of >10degree. No nonunion was seen in our study.

86% of patients achieved acceptable results according Rasmussen scoring system. About 38 % of the patients achieved the full range of motion as compared to their normal limb, 38 % of patients achieved more than 75% of their normal knee ROM as compared to their normal limb with average range of motion achieved is 110°. Three patients having peroneal nerve injury recovered completely with average time taken is 14 weeks(12-16 weeks).

IV. Discussion

All the methods available for fixation of periarticular fractures of tibia have good fracture union results but they do not address all of its problems. The main problem of these fractures is severe comminution and more chance for open injuries, which becomes difficult to be managed by open reduction and internal fixation. Even in closed injuries internal fixation results in skin problems.

Tibial plateau fractures are difficult to treat, apart from the usual problems of confining patients to bed. Conservative treatment of considerably displaced tibial head fractures though have no risk of sepsis, a short stay in hospital and the possibility that damaged ligaments might heal in plaster; but it tends to stretch the ligaments and damage the soft tissue, may be complicated by knee stiffness, malunion and non-union. Traction, in terms of ligamentotaxis and casting, permits early movement, but can have pin tract infection and several weeks in bed in hospital as well it do not properly reduce the articular surface and lack the necessary stability, leading to unacceptable rate of varus/valgus deformity, collapsed articular surface and post-immobilization stiffness [1].

Open surgical procedures, such as open reduction and internal fixation are advocated using various implants including the buttress plates, locking compression plates, cancellous screws etc.; to achieve good fracture union and optimal knee function. Despite there good reduction results, these methods do not protect the already damaged soft tissue envelope, leading to skin or muscle necrosis and to high rates of infection [6].

The twenty-first century has brought along with it a lot of changes in medical field, especially in Orthopaedic trauma. A better understanding of biomechanics, quality of implants, principles of internal fixation, soft tissue care, antibiotics and asepsis have all contributed to the radical change. With the recent development of olive wires and better understanding of circular and hybrid frames and there application to achieve axial and angular compression has increased the chances of there success in complex fracture patterns.

Polytrauma patient may be treated in external fixator as definite method with multiple bony and soft tissue injuries [7]. According to a study on the use of external fixators by Faldini et al., the average healing time was 24 weeks, nonunion occurred in 1 (3.33%) patient, varus deformity in 2 (6.25%) patients, and the mean knee ROM was 105° (range 75°–125°) [8] which is comparable to our study which showed average range of motion of 110°, malunion in 6% and average union time of 16 weeks. Catagni et al, in their series of high-energy Schatzker V and VI tibial plateau fractures treated with circular external fixator, reported excellent and good results in 30 (50.85%) and 27 (45.76%) patients [9]. Several investigators have documented good results using hybrid external fixators for patients with bicondylar fractures. Stamer and associates reported 70% good or excellent results when treating patients with Schatzker VI injuries. They obtained an acceptable reduction and fixation percutaneously in 39% of the patients with a 100% infection rate when extensive dissection was performed to allow the use of a plate in conjunction with external fixation [10]. Weiner et. al.were able to obtain a closed reduction in 2/3rd of their patients although the other one third required an arthrotomy to obtain an acceptable reduction. They documented an 82% good or excellent result and only one deep infection [11]. Dendrinis et. al. treated 24 patients with high-energy tibial plateau fractures and successfully reduced 50% with ligamentotaxis and percutaneous techniques. Seventy five percent of the patients obtained good or excellent results with only one poor result reported [12]. Comparing treatment of high-grade tibial plateau fractures internal fixation and ring fixator, Veri et al. noted high rates of wound complications and reoperation in the open reduction internal fixation utilizing single incision with dual plates group. Their results also suggested that hybrid external fixation is an effective and safe method with a low wound complications rate and early functional return [13]. Hybrid external fixator with/without open reduction and limited fixation of fracture using screws is one of the methods recently suggested to treat these fractures. Therefore it is associated with joint stability, strong fixation establishment of limb natural axis and preventing wound complications, thus can be regarded as an ideal method.

In our series we operated upon 35 patients using hybrid ring fixator with or without minimal open reduction, no major complication was seen except for two patients having malunion, three patients with peroneal nerve injury recovered completely, most common complication was pin tract infection which healed with oral antibiotics. There was no deep infection in our study. Average range of motion at the end of study was 110°.

Around 38% patient achieved normal range of motion as compared to opposite side and 38% achieved more than 75% as compared to normal side. 86% of patients achieved acceptable function according to Rasmussen scoring system. The most important factors associated with non-acceptable final outcome were open type of fractures, increased duration between injury and surgery, presence of complications, increased fracture grading and increased duration of stay in the hospital after surgery.

Hybrid external fixator proved to be an excellent surgical method in the treatment of tibial plateau fractures. It is safe, versatile and effective in providing stability and has minimal impact on underlying soft tissues. It also facilitates early knee motion thus achieving optimal knee function [14]. Fractures with substantial fragment displacement and extensive articular comminution may require limited open reduction and fixation with partially threaded cancellous screws and K wires in addition to stabilization with hybrid external fixator.

Our Study had certain limitations. This study had smaller size and there was no control group to compare our results, nevertheless it does support the use of hybrid external fixator in the management of high energy intra-articular proximal tibial fracture.

V. Conclusions

Complex Proximal Tibial fractures are difficult to treat both due to bony as well as soft tissue injury. Though these fractures have been treated with both open or minimal invasive plate osteosynthesis, treatment with hybrid fixator have shown promising results. In our study we support the use of hybrid fixator as results we obtained were excellent. Our study is a level 4 study.

Acknowledgement

None

Figure Legends

Fig 1 : Coronal CTscan Showing 41C3 Fracture

Fig 2 : AP view of Hybrid Fixator in situ

Fig 3 : Lateral view of Hybrid Fixator in situ.

Fig 4 : Clinical Photograph demonstrating knee flexion

Fig 5 : Clinical Photograph demonstrating knee Extension

Fig 6 : AP view after fixator removal and bony union.

Fig 7: Lateral view after fixator removal and bony union.

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Fig 1



Fig 2



Fig 3

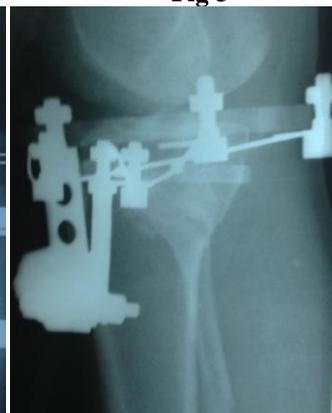


Fig 4



Fig 5



Fig 6



Fig 7

