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Research Paper

Tibia Plateau Fractures Treated By Locking Plate From Lateral Aspect

Medical Science

KEYWORDS : Tibial plateau, Locking plate, MIPO, MIPPO, Functional outcome

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ABSTRACT

Objective: To study and analyze the early results of tibia plateau fractures fixed with locking plate from lateral aspect using the method of open reduction as well as minimally invasive technique.

Introduction: Open reduction and internal fixation with plates is the gold standard method of treatment of Tibial Plateau fractures. However, multiple surgical incisions for dual plating add to the already compromised soft tissue envelope caused by high energy complex bicondylar fractures. Modern locking plating systems providing increased angular stability, low implant profile, improved design matching the periaritcular bone surface and compatible with the minimally invasive technique are nowadays the mainstay of clinical practice.

Methodology: A cohort of 43 tibia plateau fractures, treated with locking plate (both open and minimally invasive methods) from lateral side between July 2013 and December 2015 were analyzed at minimum 6 months follow-up. Fractures were classified according to the Schatzker's classification.

Results: Twenty eight patients were managed by minimally invasive technique and 15 underwent open reduction. Average time to union was 11.60 weeks. Assessment was done using the modified Rasmussen's clinical and radiological score. Excellent results were seen in 35%, good in 44%, fair in 14% and poor in 7% of patients. Statistical analysis showed that hospital stay and union time appeared independent of the type of surgical procedure. Also clinical and radiological results may vary in patients treated for tibia plateau fractures.

INTRODUCTION

Fractures involving the proximal tibia in its articular and metaepiphyseal segments are labeled as 'plateau' fractures. They usually result from axial loading in combination with varus/valgus forces[1]. Open reduction and internal fixation with plates and screws is considered gold standard method of treatment[2]. The aims of operative treatment in these fractures are anatomical reduction, rigid fixation and early mobilization. Simple plates applied by buttressing principle provide support only on the surface applied. Bicondylar displaced fractures treated with such plates require multiple extensile incisions which might compromise soft tissue envelope. Modern locking plating systems providing increased angular stability, low implant profile, improved design matching the periaritcular bone surface and compatible with the minimally invasive technique (MIPO-Minimally Invasive Plate Osteosynthesis) are nowadays the mainstay of clinical practice. The main purpose of this study was to study and analyze the early (minimum six months) results of tibia plateau fractures fixed with locking plate from lateral aspect using the method of open reduction as well as MIPO technique.

METHODOLOGY

This study focuses on tibia plateau fractures as identified by the Schatzker's classification. However due to the rarity of a true Type V Schatzker's fracture, all bicondylar fractures were included in a single group. This observational prospective study was conducted at a tertiary care hospital between July 2013 and Dec 2015. Fifty four patients with Tibial plateau fractures were enrolled in the study based on the following inclusion and exclusion criteria.

Inclusion Criteria:

- All the fractures with intra articular extension, with recent (<4 weeks) history of trauma.
- Closed fractures, open grade I and open grade II fractures were included.

Exclusion Criteria:

- Pathological fractures
- Fractures in children (< 18 years)
- Old neglected fractures
- Pregnant females
- All open grade III fractures
- Crush injuries
- Previously operated fractures
- Fractures with existing or impending compartment syndrome
- Neurological problems (local or general) which could affect the functional outcome assessment.

With 9 patients being lost to follow-up during the course of study before completing at least six months of follow-up we had 45(37M, 8F) patients remaining to study. Two fractures of type IV were not included in the final analysis.

Surgery in closed fractures was planned depending on swelling and in open fractures depending on healing of wounds. Awaiting surgery these fractures were immobilized with splint and distal tibial skeletal traction. The fracture pattern dictated the operative procedure. Fractures of type I, II, V and VI were attempted to be reduced by ligamentotaxis and manipulation on traction table and proceeded with MIPO if successful. Articular step fractures irreducible by closed techniques, fractures of type III and IV were taken up for open reduction. All fractures were initially fixed with locking plate on lateral side. Additional fixations in form of medial plate or medial-to-lateral screws were used if primary fixation was found deficient. Depending on fixation stability and postoperative pain tolerance, quadriceps strengthening exercises, knee and ankle mobilization and crutch walking was started.

Data related to demographics, trauma details, hospitalization, surgery, complications and functional outcome were collected during the period of hospital stay and follow-up visits in opd clinic. On follow up(minimum six months) the patients were evaluated clinically and radiologically according to the modified Rasmussen's criteria for clinical and radiological evaluation. Descriptive statistical methods and expression of results in terms of mean, chi-square test and others using Microsoft excel software with significant p value <0.05 were used for computation of data.

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OBSERVATIONS AND ANALYSIS

A sample size of 45 (37 male, 8 female) patients (Table 1) was selected to evaluate fractures of Tibial plateau treated by locking plate from lateral side using either open reduction (15) or MIPO (28). Majority (37) of the patients were in the age group 31-40 years (Range 18-60 years). The predominant cause of trauma was a road traffic accident (76%). Ten patients had associated injuries sustained during trauma that could have directly or indirectly influenced the functional outcome of patients as well as the data analysis.

SchatzkerType Type of Fracture	I	II	III	IV	V & VI	Total
Closed	3	19	1	2	15	40
OG-1	1	0	0	0	1	2
OG-2	1	0	0	0	2	3
Total	5	19	1	2	18	45

Table 1. Schatzker classification and type of fracture

Preference to MIPO was given whenever possible, in deciding the surgical method of fixation. Most (35) patients were operated within first week of trauma. Average time period from injury to surgery was 4.0 days. Thirty four fractures united between 12-24 weeks. Average time of union was 11.60 weeks. Open fractures did not obviously show any abnormal delay in union time. Hospital stay and union time appeared independent of the type of surgical procedure (Table2).

Method	Mean hospital stay	Mean time to union	Number of patients
Open	11.73	15.067	15
MIPO	10.85	11.714	28
P value	0.8090	0.3115	43

Table 2. Hospital stay and union time versus surgical procedure

We had achieved <5 mm articular step-off intra-operatively in all except one patient, who had reasonably good result at 6 months follow-up. However, 3 patients developed articular depression of >5 mm during follow-up. Articular depression was not significant enough in any patient so as to affect knee range of motion. The mean loss of extension was 7.2° and mean flexion was 112.8°. 73% (n=32) had full range of movement at knee joint. 2 patients developed knee stiffness. (Figure.1)

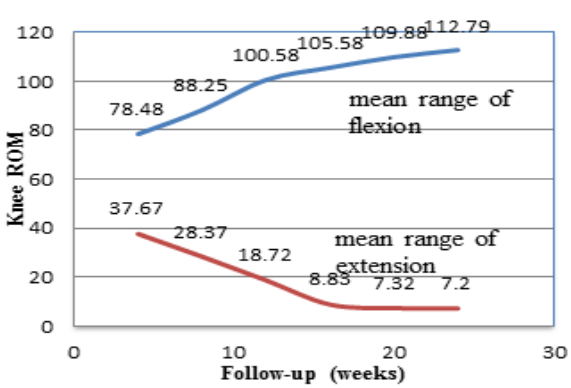

Figure 1. Progression of range of motion following surgery

Thirty one patients started weight bearing at 8 months of follow-up and 8 patients at 12 weeks. 4 patients required prolonged immobilization. Complications were seen in 10 patients. Of these, two patients had joint stiffness but were able to ambulate independently; implant removal due to infection was done in 2 cases and one patient encountered implant failure due to progressive varus. Rasmussen's criteria showed 15 (35%)excellent and 19(44%) good and 6(14%) fair functional scores (Figure 2). Only 3 (7%) patients scored poor on functional outcome. Average functional score was 25.76 and average radiological score was 8.24.

Figure 2. Pre-op & Post-op X ray of Bicondylar fracture of tibial plateau with excellent outcome.

Excellent results were more commonly seen in closed fractures, type II Schatzker's and fractures treated by MIPPO. By statistical analysis (Table 3) we concluded that clinical and radiological results may vary in patients treated for tibia plateau fractures.

Results according to Rasmussen's Scoring system					
Clinical Radiological	Excellent	Good	Fair	Poor	Total
Excellent	15	6	0	0	21
Good	0	13	3	1	17
Fair	0	0	3	2	5
Poor	0	0	0	0	0
Total	15	19	6	3	43

(Chi-square - 43.096, Degree of Freedom- 6, Significance level P- < 0.0001 (0.00007677), Contingency coefficient- 0.708)

Table 3. Comparison of clinical and radiological results

DISCUSSION

Fractures of the tibial plateau constitute about 8% of all fractures in elderly and 1% overall. Published studies have shown that majority of the injuries affect the lateral tibial plateau (55-70%)[3]. Isolated medial plateau fractures occur in 10-23% of the cases, while bicondylar lesion is found in 10-30% of reported cases [4]. Our series also showed a similar pattern of fracture distribution.

Fractures of tibia plateau are quite challenging to manage & notoriously difficult to reduce, align and stabilize and are prone to develop wound complications and infections. The usefulness of a staged approach and delayed fixation until local conditions are optimized has been documented by authors [3,5]. In our study group as well as in other similar studies [6,7,8] minimally invasive techniques with application of locking plating systems offered the ideal combinations in terms of bone fixation and soft tissue sparing. The advantage of MIPPO plating include biological fixation without extensive soft tissue stripping, low infection rates, earlier mobilization and shorter duration of hospital stay. The low incidence of infection in our study can be attributed to the fact that due care was taken to delay surgery in excessive soft

tissue swelling, judicious use of MIPPO and avoiding medial incisions. However, in our series we did not find any statistically significant difference in hospital stay between open reduction and MIPPO. This could partially be attributed to the associated injuries that these patients had and also to the reluctance of the patients to go home without suture removal to avoid transport expenses. In our study, analysis showed that time to union was independent of surgical method used. Literature is deficient in examining the union time in relation to the surgical method used. However the average time to union (12.88 weeks) in our study corresponds to published studies in the Indian scenario [9]._

A significant finding of our study was that functional and radiological outcomes did not show any correlation between the two. Duwelius and Connolly[10] reported good results after non-operative or limited surgical approaches and noted that excellent clinical outcomes did not correlate well with the radiographic appearance of the knee. Some bias or error in judgment of radiographs is inherent in these types of studies. The better functional results in our study may be because of medium energy trauma, early appropriate treatment, young patients in the sample size (average age 39 years) and the exclusion criteria applied.

A similar study by Mathur et al [11] involving 27 closed tibia plateau fractures treated with conventional plates showed excellent Rasmussen score in 37% and good in 52% of cases. These results are almost similar to that seen in our study. However their patient cohort had mainly low energy fractures with Schatzker type V & VI fractures accounting for 18 % of injuries as compared to 40 % in our group.

With the introduction of locking plates, many limitations of conventional plating have been overcome. The angle stable locking screws allow screw fixation of the opposite condyle with a single plate, indirect reduction technique and stable fracture fixation[12,13] thus avoiding extensive soft tissue dissection[14]. Main problem for the treatment of split depression fractures where the reason is usually a minor trauma is not infection but secondary loss of reduction due to missing stability of conventional implants, especially in osteoporotic bones [15,16,17,18,19,20,21]. Unilateral plate fixation for treatment of bicondylar fractures as well as split depression fracture seems to offer advantages in particular concerning infection rate and implant failure. Our own collective consisted of 18 patients with a bicondylar Schatzker type – V & VI tibia plateau fracture. Of these 9 required only a lateral locking plate and 5 others an additional medial supporting screw. All these cases would have required a bilateral conventional double, plate osteosynthesis, if treated without locking plate & screws. No loss of reduction, especially of the contralateral tibia plateau, occurred.

Obtaining proper alignment is technically demanding with the Locking plate system. Traditional constructs bend the plate to bone with the tightening of screws. However, insertion of fixed-angle screws does not pull the bone to plate with screw tightening because of locking screws. Satisfactory alignment must be obtained independent of the relative contour of the bone and plate. If the bone is properly aligned without being completely in contact with the plate, then the fixed angle screws should be inserted to maintain this alignment because reducing the bone to the plate with clamps or other instruments will only introduce malalignment. There are few conditions like severely comminuted intra-articular fracture component which require selection of traditional implants. Locking plate provides two proximal screws that angle slightly away from the articular surface. This configuration supports the medial side from collapsing into varus, but it is difficult to get these screws proximal enough to support the medial subchondral bone. In addition locking systems should not be 'overused' by placing locked screws when not needed (or more than what is needed). The resultant relative lack of motion at the fracture site can, in some situations, be too stiff to allow fracture healing. Newer techniques such as "hybrid" plating (use of both locking and non-locking screws in a single construct) and far cortical locking (obtaining purchase in far cortex while bypassing proximal cortex) have evolved to combat these problems sometimes seen with locking plate.

This study has inherent limitations related to its design, the absence of randomization between different treatment strategies, the short period of follow-up, as well as in terms of the accuracy and reproducibility of the radiographic interpretations. Still there are results in our study which show trends that approach the accepted level of significance.

CONCLUSION

Based on our study and with support of literature we recommend a staged approach, minimally invasive techniques, use of fixed angle construct that allows early range of motion and restoration of articular congruity for improving the outcome of this fracture. A study with better design, large number of subjects and better level of evidence will further clarify the role of locking plates in tibia plateau fractures.

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