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A prospective study of management of tibial plateau fractures by locking compression plate in adults

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ABSTRACT

Background: Tibial plateau fractures are one of the most complex and disabling fractures of the knee. The tibial plateau is important in transmitting load through the knee. These fractures need a meticulous management protocol in order to minimize patient's disability in range of movement, stability and reducing the risk of documented complications. The aim of the present study is to study the outcome of tibial plateau fractures managed with a locked compression plate.
Methods: This study was conducted at a tertiary-care medical college and hospital, Aurangabad specializing in post-graduate training, where all patients who underwent surgical treatment between September 2018 and October 2020 were included. Patients were assessed using the knee society score (KSS). These evaluations were done at 1, 3, 6, 9 and 12 months.
Results: In our study we included 55 patients out of which we found union in 98% of patients with 83% of patients showing good flexion at knee joint (>110 degrees). 85% patients achieved union within 6 months. An excellent KSS grade was seen in 38.2% patients with another 43.6% showing good outcome. 4 patients showed infection and 1 showed non-union. A single case of malunion was seen in our study.
Conclusions: Locked compression plates in tibial plateau fractures has revolutionized the way these fractures are managed. Anatomic reduction is of utmost importance. Early physiotherapy which plays key role in preventing knee stiffness, use of bone grafts and good fixation are important for successful outcome.

Keywords: Tibial plateau fractures, Knee society score, Schatzker classification

INTRODUCTION

Ever since the advent of high velocity transport system, there is an alarming increase in road traffic accidents (RTA) with increased orthopaedic related morbidity and mortality.

Tibia plateau being involved in body weight transmission through knee joint and leg, it plays a vital role in knee function and stability. Fractures of tibial plateau have historically been difficult to treat because of the subcutaneous location of the antero-medial surface of the tibia. Severe bone and soft tissue injuries is not infrequent and there is high incidence of open fracture compared with other long bones.[1]

These fractures are also predisposed to complications like compartment syndrome and injury to the neurovascular structures and soft tissue envelope. The objective of treatment is to attain fracture union with a stable knee joint with a functional painless range of motion. The aim of surgical treatment of tibial plateau fractures is to restore and preserve normal knee function, which can be accomplished by anatomical restoration of articular surfaces, maintaining mechanical axis, restoring ligamentous stability and preserving a functional pain free range of motion of knee.[2-6]

Over the last decade plate fixation has become popular for the treatment of fractures of proximal tibial fractures. This coupled with biological advantage of percutaneous insertion has resulted in high union rates. Locking compression plate device offers potential biomechanical advantage over other methods by better distribution of forces across the fracture site, better hold in osteoporotic bones with unicortical fixation option with decreased chances of secondary reduction loss due to locking screws. It provides stable fixation and also has the ability to manipulate the smaller fragments and reduce them directly.[7]

With newer plates and better imaging of fracture configuration, it is also possible now to plate the tibial plateau fractures with minimally invasive procedure (MIPPO). Many complications have been seen with plates like infection, malunion, delayed and non-union, knee stiffness and implant breakage. Many of these failures, such as post-operative malalignment or loss of reduction, malunion and implant breakage are due to a wrong evaluation of the fracture morphology and improper post-operative rehabilitation. In fact, comminuted fractures, dislocation and rotation of the medial tibial plateau cannot be stabilised just with lateral angular stable plates, but fixation of the medial tibial plateau must be performed first.[8,9]

In this study we have attempted to assess the benefits and shortcomings of locked compression plate for a tibial plateau fracture in a tertiary care center with respect to time to union, range of motion and complications.

METHODS

All patients with tibial plateau fractures above 18 years of age admitted in government medical college and hospital, Aurangabad between September 2018 and October 2020 were included in the study. This is a prospective type of study done to analyse the various factors involved in optimum healing of tibial plateau fractures.

The sample size was calculated according to the sample size formula with 90% confidence level and 6% allowable error which rounded upto 51 subjects.

$$Sample\ size\ formula = \frac{z^2 \times p(1-p)/e^2}{1 + (z^2 \times p(1-p)/e^2 N}$$

Where, z=1.65, p=0.5, e=0.6, N=70 (incidence of tibial plateau fractures accounts to about 7 per 1 lakh population annually with population of Aurangabad being about 10 lakhs).

The inclusion criteria were as follows: age group adults (>18 years), radiologically diagnosed tibial plateau fractures, consent to participate in the study, open fractures Gustillo Anderson type I and II; whereas the exclusion criteria were as follows: age group (<18 years), compartment syndrome requiring fasciotomy, open fractures Gustillo Anderson type III, tibial plateau fractures needing neurovascular repair and refusal to provide informed consent.

Pre-operative x-rays of knee with leg (antero-posterior and lateral view) and computed tomography (CT) were taken for assessing the fracture pattern. General work-up of the patient was done (complete blood count, liver function test, kidney function test, blood sugar level, prothrombin time) along with any specific investigations if advised by physician and anaesthetist.

All tibial plateau fractures were graded preoperatively using Schatzker classification.[10] The functional outcome of the patients were assessed using knee society score (KSS).[11]

Operative technique (Figure 1) Patient was placed in supine position with a bolster under the same side hip and knee. The procedure was carried out under spinal anaesthesia with or without epidural anaesthesia or general anaesthesia. Tourniquet was applied. The operating limb was thoroughly scrubbed with betadine scrub (7.5%) and painting done with betadine solution (5%) and kept for 3 minutes. Appropriate draping done for thigh and leg. Operative site cleaned with spirit.

Incision taken either in a lazy S fashion on the anterolateral aspect or a straight incision posteromedially (Figure 1a). Compression bony clamp was used in cases to bring the fracture fragments together to achieve the reduction. After confirming the reduction under image intensifying television (IITV) guidance, fixation of the fracture was done with locking compression plate - either an anterolateral plate or posteromedial buttress plate depending on the fracture pattern (Figure 1b and 1c). In case of Schatzker type II or III fracture, the depressed fragment was elevated with Steinmann pin/K-wire with or without bone grafting followed by plate fixation under image intensifying television (IITV) control Tourniquet deflated. Any obvious bleeder either cauterized or ligated to achieve haemostasis drain kept. The wound is closed in layers (Figure 1d) sterile dressing done. Additional support in case of gross comminution or unstable fixation is given by long knee brace or above knee slab for 3 weeks. Postoperatively standard anteroposterior and lateral x-rays of leg with knee taken. Drain removed after 24 hours.

IV antibiotics (injection ceftriaxone 1 gram 12 hourly and injection amikacin 500 milligrams 12 hourly) given for 5 days and then shifted to oral antibiotics (tablet ciprofloxacin 500 mg 12 hourly) for further 7 days. Check dressing done on 3rd and 7th day. Stitches removed on the 11th day. In case of stable fixation, knee range of motion started on the 4th post-operative day. Regular follow-up done at 1, 3, 6, 9 and 12 months and patient evaluated for fracture union, wound condition and range of motion at knee joint (Figure 2-5).

Statistical analysis was done on Microsoft excel sheet using statistical package for the social sciences (SPSS) 25 and. It was done using Microsoft excel 2010 and Microsoft word 2010.

RESULTS

Majority of the patients were males and in the age group of 30-50 years with right sided predominance. Schatzker type V and VI were the most common fracture patterns observed (Table 1).

Table 1: Demographic data of patients.

Criteria	Number of patients (%)
Age	
20-29	10 (18)
30-39	16 (29)
40-49	18 (32)
50-59	08 (15)
60-69	01 (2)
70 or above	02 (4)
Sex	
Male	52 (95)
Female	03 (5)
Side of injury	
Right	33 (60)
Left	22 (40)
Mode of injury	
Road traffic accidents	43 (78)
Fall from height	09 (16)
Household injuries	03 (6)
Schatzker classification	
I	08 (15)
II	03 (5)
III	01 (2)
IV	04 (7)
V	15 (27)
VI	24 (44)
Type of plating	
Anterolateral	49 (89)
Posteromedial	04 (7)
Dual plating	02 (4)

Good results were obtained in 43.6% and excellent results in 38.2% of the patients. Fair results in 14.5% and Poor results were obtained in only 3.6% of the patients (Table 2).

Table 2: Knee society score grade.

S. no.	Grade	No. of cases	Percentage
1	Excellent	21	38.2
2	Good	24	43.6
3	Fair	08	14.5
4	Poor	02	3.6

Mean union time was about 4.4 months with 85% patients showing radiological union within 6 months. 2 patients showed delayed union with 1 showing non-union. Mean range of flexion was found to be 117 degrees, with 83% of the patients showing functional range of flexion (110 degrees or more). 3 patients showed an extension lag of 5 degrees while one other patient had an extension lag of 10 degrees (Table 3).

Table 3: Clinical outcome.

Criteria	Number of patients (%)
Time for radiological union (months)	
<6	47 (85)
6-9	05 (9)
9-12	02 (4)
Flexion ROM (degrees)	
<90	02 (4)
90-105	07 (13)
≥110	46 (83)
Extension lag (degrees)	
<10	03 (6)
10-20	01 (2)
>20	00 (0)

Overall complication rate was 20% out of which 7% (4 patients) had infection out of which 1 patient were controlled on antibiotics. 1 patient had to be given a wound wash while 2 patients have had to have their plate removed followed by external fixator application. One of these patients who was a chronic smoker and diabetic developed deep infection which was managed by removal of plate and repeat wound washes and debridements with proper blood sugar level control and antibiotics according to the culture and sensitivity report. The wound healed but the fracture went into non-union. Uncontrolled diabetes was found to be associated with high risk of infection in these patients. 2% (1 patient) had varus malunion but not too significant as to warranty corrective surgery. 2% (1 patient) showed articular depression radiologically but patient did not complain of any symptoms due to it. 3.6 % (2 patients) had knee stiffness. Nonunion was seen in 2% (1 patient) who was managed with implant removal with external fixator with repeated debridements to manage the infection first followed by bone grafting and plate application secondarily. Delayed union in 3.6 % (2 patients) (Table 4 and Figure 6).

Table 4: Complications.

S. no.	Complication	No. of cases	Percentage
1	Infection	04	07
2	Knee stiffness	02	3.6
3	Varus malunion	01	02
4	Delayed union	02	3.6
5	Non-union	01	02
6	Articular depression	01	02

Figure 1: (a) Incision with reduction maneuver to hold the fragments, (b) intraoperative fluoroscopic anteroposterior view, (c) intraoperative fluoroscopic lateral view, and (d) intraoperative closure of wound.

Figure 2: Pre-operative, post-operative X-ray and clinical picture of Schatzker type I fracture.

Figure 3: Pre-operative, post-operative X-ray and clinical picture of Schatzker type III fracture.

Figure 4: Pre-operative, post-operative X-ray and clinical picture of Schatzker type V fracture.

Figure 5: Pre-operative, post-operative X-ray and clinical picture of Schatzker type VI fracture.

Figure 6: 12 month's post-operative X-ray showing articular depression and varus displacement.

DISCUSSION

The advent of locked compression plates has been a game changer in the management of tibial plateau fractures. Intra-articular fractures need proper anatomic reduction with rigid fixation for a painless bony union to occur.[12,13]

The average time to union which was determined radiologically was about 4.4 months. 2 of our patients had delayed union taking 10 and 11 months respectively for union.[14,15] Both of these patients had infections post-operatively which could explain the delayed union.

Since tibial plateau fractures are complex fractures, it is associated with a number of complications. In this study, 4 patient had an infection, of which 1 was controlled by higher antibiotics, 1 patient had to be given a wound wash while 2 patients have had to have their plate removed followed by external fixator application.

We try to reduce the rate of infection by observing meticulous pre-operative hygiene - hand wash and proper preparation of surgical site just before surgery. According to fracture pattern, we used dual plating in 2 patients by separate incisions.[16] The commonest organisms in these infections were *Staphylococcus aureus*, methicillin resistant *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Klebsiella pneumococcus*. Wherever possible a minimally invasive surgery can be done to reduce soft tissue injury without compromising on the

reduction of the articular surface.[17] Another factor which influenced infection rates was the operative time required and the experience of the surgeon performing the procedure.[18]

One patient developed varus deformity but not too severe to require a second operation for its correction. No limb length inequality or rotational deformities were encountered.[19]

No case of hardware irritation requiring implant removal was seen nor was any nerve injury detected in any of the cases. 2 patients developed knee stiffness out of which 1 patient obtained a functional range of motion of the knee after physiotherapy while the other patient required manipulation under general anaesthesia to regain full motion at knee.[20-22]

We waited for an adequate amount of time after the patient was admitted with tibial plateau fracture for his edema to subside and blisters if any to heal as tibial plateau fractures are generally associated with bad local skin conditions such as edema, bruises, blisters and contused skin. Generally edema and local skin conditions improves by 7-10 days after elevation, anti-edema medicines (trypsin, chymotrypsin and serratiopeptidase) and local magnesium sulphate dressing.

All the patients in this study were encouraged to start knee range of motion exercises on post-operative day 2 itself. However full weight bearing was not started immediately but initiated after about 3 weeks even in stable rigid fixations. In these 3 weeks, the patient was made to stand up supported and walk with the help of walker.[23,24] Patients who did not adhere to these essential post-operative rehabilitation protocols had a decreased range of knee flexion and 2 patients also developed knee stiffness.

This is a short term study to assess the functional outcome of tibial plateau fracture plating done in a small number of patients within the same demographic area. A larger sample group would be required to extrapolate the results and better understand the risk factors associated with infection rates, time required for union in different age groups and sex, appropriate time to wait before operating on a tibial plateau fracture and time after which full weight bearing can be done.

CONCLUSION

Locked compression plates in tibial plateau fractures has revolutionized the way these fractures are managed. It has the following advantages- Anatomic reduction of the articular surface is of utmost importance. Computed tomography of the fracture is very important to achieve the above mentioned point, as most of the times, X-rays do not reveal the actual fracture pattern and position of fragments. So segment specific fixation is possible after thorough review of computed tomography films. In case of depressed fractures, autogenous cancellous tricortical bone graft from iliac crest is found to be beneficial to fill the void after elevating the depressed fragment which prevents secondary collapse. Early active and active assisted physiotherapy is essential for successful outcome. With advent of newer locking plates, good quality fixation can be achieved and mobilization is possible from a very early stage post-operatively.

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