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A prospective study on clinical, functional and radiological outcome of proximal tibia fractures treated with internal fixation by plating

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Abstract

Background: Proximal tibia fractures are one of the most common fractures encountered. Anatomical reduction, joint reconstruction, and good primary stability are among the surgical goals in order to enable early functional rehabilitation.

Methods: In this study we have attempted to evaluate the clinical, functional and radiological outcome of internal fixation by plating in proximal tibia fractures. We included 31 patients in our study, that were treated by internal fixation by plating. Patient follow up was done over a period of 2 weeks, 6 weeks, 12 weeks and 24 weeks to assess the functional outcome, fracture union and complications.

Results: The results were evaluated using the Honkonen Jarvinen Criteria and the Lysholm Knee Score.

Conclusions: We concluded that proximal tibial locking plates are an effective tool for stabilising intra-articular tibial plateau fractures, When used in conjunction with careful intra-operative treatment of soft tissues and active patient engagement in the rehabilitation programme.

Keywords: Fixation, proximal tibia

Introduction

Tibial plateau fractures are fractures of the proximal tibia that extend into the knee joint. Proximal tibia being involved in body weight transmission through knee joint and leg, plays a vital role in knee function and stability and injuries in this area frequently result in functional impairment^[1]. One of the most frequent fractures seen is the proximal tibia fracture. Since the proximal tibia is one of the principal weight-bearing surfaces in the lower limb, the best course of therapy for these fractures is crucial. This depends primarily on the accuracy of the articular reduction and the health of the soft tissues in the area^[2].

These fractures cover a wide range of fracture arrangements involving the medial, lateral, or both condyles, along with different degrees of articular depressions and displacements. Each form of fracture has a unique morphology and therapeutic response. Determining the force of the injury is crucial since high energy trauma is linked to significant soft tissue and neurovascular damage. In addition to the tibial plateau, meniscal tears and ligament injuries need to be evaluated.

For tibial plateau fractures, there are a variety of treatment methods available, ranging from Ilizarov fixation to conservative therapy. Casting, bracing, and motion and weight-bearing restrictions are all examples of non-surgical treatment. Despite the fact that there are several surgical treatments accessible, success is not always guaranteed. To prevent severe complications, the functional result of a surgically treated tibial plateau fracture needs to be assessed for correct patient selection, surgical timing, and implant usage^[3].

Anatomical reduction, joint reconstruction, and good primary stability are among the surgical goals in order to enable early functional rehabilitation^[5]. Several solutions are available to satisfy these requirements, with open reduction and internal fixation employing locking plate systems serving as the current gold standard^[4, 5, 6].

Methods

Our study was a prospective study carried out to evaluate the clinical, functional and

radiological outcome of internal fixation by plating in proximal tibia fractures.

The patients of tibial plateau fracture were treated surgically by internal fixation with single or dual plating.

Place and duration of study

The present study was carried out at Sri Guru Ram Rai Institution Medical Sciences Dehradun, Uttarakhand, India from October 2020 to May 2022. Patients were operated in this duration for tibial plateau fractures by internal fixation with plating.

The inclusion criteria were: Patients admitted with history of trauma & diagnosed to have all types of closed tibial plateau fractures (Schatzker I to VI). All patients between 18-80 years of age. All patients who were ambulatory before the injury.

The exclusion criteria were: Patients with associated ipsilateral limb fractures, tibial plateau fractures treated conservatively with casting, pathological fractures, fractures with neurovascular injury, fractures associated with knee joint dislocation and open fractures.

Procedure

A total of 31 patients with tibial plateau fractures were included in this study. Schatzker classification was used to classify fracture, based on the radiographic study. A preoperative assessment of the radiograph was done to assess the length and position of the plate and screws as well as to assess the required surgical approach. All the patients received a prophylactic antibiotic pre and intraoperatively in the form of 1.5 gm of cefuroxime intravenously.

We have used an Indian-made LCP (Fig. 1) in the treatment of tibial plateau fractures. It is a pre-bent fixed angle plate with the dual function of achieving compression at the fracture site when required and obtaining rigid fixation by locking screws to the plate, in turn reducing the plate backout and providing angular stability. The locking screws are self-tapping and available in 3.5mm and 4.5mm thicknesses.



Fig 1: Implants used for the study

Spinal anaesthesia was given to the patient and the patient was placed supine and a tourniquet was applied over the proximal thigh. The limb was draped up to the level of tourniquet and iliac crest was prepared in cases where bone grafting was required. According to the pre-operative plan and the type of fracture, the appropriate approach was chosen and an anterolateral/ posteromedial/ posterior incision was given. Deep dissection was carried out and full-thickness flaps were raised consisting of subcutaneous fat down to the fascia. The meniscus was preserved in all the cases and submeniscal arthrotomy was carried out to visualize the articular surface. The fracture geometry was well understood and then reduction was done accordingly, checked and fixed provisionally with K-wires under the guidance of C-arm.

Thereafter locking compression plate/ buttress plate was placed and 6.5 mm cancellous screws were applied in the metaphyseal region and cortical/ locking screws were applied in the diaphysis.

Medial plating and posteromedial plating (Fig. 2) were done on the medial side and posteromedial side, lateral plates were applied on the lateral side to maintain the articular congruity and prevent fracture collapse. In certain cases, iliac crest cortico-cancellous bone grafting was done to maintain the articular congruity and CC screw augmentation was done in cases where required. In cases where soft tissue conditions were not favourable, patients were initially managed by knee-spanning external fixator and were later managed by internal fixation by plating once soft tissue conditions improved.



Fig 2: Posteromedial plate and screw fixation

Knee range of motion exercises, quadriceps and hamstring strengthening exercises were started from 1st post-operative day.

Unrestricted range of motion exercises were allowed from the 1st week onwards.

They were followed up at 14 days, 6 weeks, 12 weeks and 24 weeks post-operatively (Fig. 3, 4) to assess the clinical, radiological and functional outcome according to HJ Criteria [7] and Lysholm Knee Score [8]. Partial weight-bearing walking was allowed from the 6th week onwards. Further, full weight bearing was allowed depending on the progress of the fracture healing pattern clinically and radiologically.



Fig 3: Pre-op and immediate post of Xray of a case with Schatzker type VI fracture treated with dual plating.

Ethical approval

The proforma of the study was reviewed by the ethical

committee of Sri Guru Ram Rai Institute of Medical and Health Sciences and approval was given after establishing that the study was to be done in accordance with the guidelines of the declaration of Helsinki.

Data analysis

Statistical evaluation was done using the statistical package for the social sciences (SPSS) software version 22.0. Quantitative and qualitative variables were analysed using the student’ t-test and chi-square test respectively. The p-value of less than 0.05 was considered to be statistically significant.



Fig 3: Follow-up Xrays of a case with Schatzker type VI fracture treated with dual plating.

Results

When used in conjunction with the intra-operative treatment of soft tissues and active patient engagement in the rehabilitation programme, proximal tibial locking plates are an effective tool for stabilising intra-articular tibial plateau fractures.

31 cases were in the study and most patients belonged to the age category 31-40 years (32.25%). The mean age was 41.32 years. On evaluation of the gender distribution we found that of the 31 cases in the study most patients were males (74.20%) and on evaluation of the mode of injury it was found that most patients were injured by Road Traffic Accidents (67.74%) while the remaining got injured due to slip and fall (Fig. 5). There was an almost equal distribution of the side of involvement in our study. Out of the 31 cases in the study most patients had Schatzker type VI (61%) (Fig. 6). The time interval between trauma and surgery, in most cases, was less than 1 week (64.52%). Out of the 31 cases, dual plating was done in 17 cases (54.84%) while the remaining 14 cases had single plating. The duration taken for the fracture union was 20-22 weeks in most patents (77.43%), the mean duration for fracture healing was 21 weeks. In our study, 3 patients (9.68%) had infection as they had serousanguinous discharge from the stitch line. Infection in 2 patients was managed with i.v antibiotics as per culture sensitivity reports and 1 patient had to undergo wound debridement and re-suturing in the OT followed by i.v. antibiotic coverage and regular dressings. 4 patients (12.90%) complained of plate prominence. 1 patient (3.23%) showed malunion as the fracture was fixed in valgus, despite inadequate fixation, the patient had full functional outcome. 2 patients (6.45%)

showed delayed union due to a habit of smoking and restricted knee movement after surgery was seen in 3 patients (9.68%) as they were non-compliant to post operative physiotherapy instructions. 18 patients had no complications. In the present study on evaluation of the final outcome of the fracture most patients had excellent results according to HJ Criteria (74.20%) (Fig. 7), at the end of 24 weeks the outcome was excellent according to Lysholm Knee Score in majority patients (74.20%) (Fig. 8).

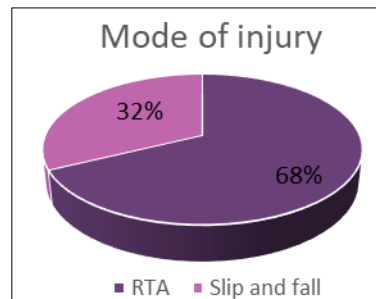


Fig 5: Distribution of mode of injury

Fig 6: Distribution Schatzker types

Classification	No. of cases	Percentage
I	2	6.45%
II	3	9.68%
III	1	3.23%
IV	1	3.23%
V	5	16.12%
VI	19	61.29%
TOTAL	31	100.0%

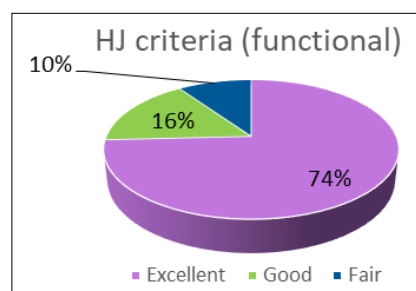


Fig 7: Functional outcome according to HJ criteria at 24 weeks

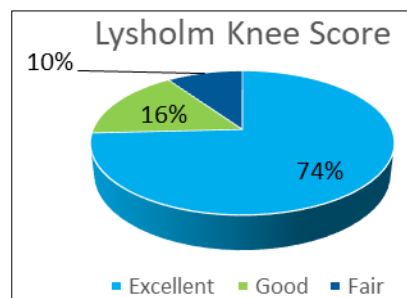


Fig 8: Functional outcome according to Lysholm Knee Score at 24 weeks

Discussion

In our study, majority of the patients suffered such fractures after high velocity road traffic accidents (67.74% of cases; 21 patients), and the remaining were after a slip and fall (32.26% of cases; 10 Patients). Injuries were caused by auto-versus-pedestrian accidents in 17 patients, motor vehicle accidents in 11 patients, falls in 4 patients, blows in 2 patients, and shotgun wounds in 1 patient, according to Lee *et al.* (2006) [9].

All the 31 fractures analysed in this study were graded in accordance with the Schatzker classification where 2 were type I, 3 were type II, 1 was type III, 1 was type IV, 5 were type V and 19 were type VI. Sangwan *et al.*^[10] classified the fractures according to the Schatzker *et al.* criteria as type I in 9 patients, type II in 1, type IV in 5, type V in 2, and type VI in 8 patients.

The healing process was determined clinically and radiologically. In our study the mean time to union was 21 weeks, with 77.5% of fractures uniting in 20-22 weeks. The 34 fractures in Lee *et al.*'s study^[9] took an average of 4.2 months to heal (18.25 weeks). At a mean age of 15.6 weeks, union was visible in 34 fractures, according to Stannard *et al.*^[11]

In our comparison of follow-up after 12 weeks and follow-up after 24 weeks. Using the Honkonen Jarvinen Criteria, we found that the HJ score at 24 weeks (Mean=1.35; SD=0.66) was lower than the score at 12 weeks (Mean=1.55; SD=0.68) signifying an improvement in the functional outcome from 12 weeks to 24 weeks due to our intervention and not by chance ($t=2.68$; $P<0.01$). In our comparison of follow-up after 12 weeks and follow-up after 24 weeks. Using the Lysholm Knee Score, we found that the Lysholm Knee score at 24 weeks (Mean=94.19; SD=5.38) was significantly higher than the score at 12 weeks (Mean=88.97; SD=7.35) signifying an improvement in the functional outcome from 12 weeks to 24 weeks due to our intervention and not by chance ($t=-6.80$; $P<0.01$). The range of motion in the Schutz *et al.* study^[12] was 0-105 degrees. After full healing, a limitation of an average of 85 degrees was seen in three cases. In one instance, a 10 degree extension loss was noted. The study came to the conclusion that when used for the treatment of proximal tibial fractures, the proximal tibia LISS system ensured stable stabilisation till recovery.

As a result, the proximal tibial locking plate is an effective tool for stabilising proximal tibia fractures, particularly when used in conjunction with careful intraoperative management of soft tissues and active patient engagement in the rehabilitation programme. In conclusion, locking compression plates are an effective bone stabilisation tool, even in situations when soft tissue injuries have occurred.

Limitations of the study

- COVID-19 pandemic vastly affected the number of patients reporting to the hospital, surgical intervention and subsequent follow-up of the patients.
- Our sample size was small.
- The mean follow up period was a maximum of 6 months in these cases.

Conclusion

When used in conjunction with careful intra-operative treatment of soft tissues and active patient engagement in the rehabilitation programme, proximal tibial locking plates are an effective tool for stabilising intra-articular tibial plateau fractures.

The goal of the surgical procedure is to achieve accurate reconstruction of the articular surface, elevation of the depressed bone fragment by bone grafting, stable internal fixation, and early range of motion.

From our study we conclude that tibial plateau fractures treated with locking compression plate with open reduction internal fixation gives excellent results in the present scenario.

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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