

Original Research Article

Surgical management of proximal tibial fractures with locking compression plate

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ABSTRACT

Background: Incidence of proximal tibial fractures is increasing due to increasing incidence of road traffic accidents (RTA). Knee joint being one of the major weight bearing joint of the body, appropriate management of fracture around it will be of paramount importance in maintaining mobility. The recent development of locking compression plate (LCP) has revolutionized the treatment of proximal tibial fractures by overcoming the few drawbacks of conventional buttress plate.

Methods: We studied 30 patients involving proximal tibial fracture managed using LCP [23 patients with minimally invasive plate osteosynthesis, (MIPO) technique and 7 patients with Open reduction and internal fixation (ORIF) technique]. We followed up all the patients until complete union of fractures.

Results: The average time for union of fracture was 14 weeks (range: 12-24 weeks). Overall 96.7% patients had acceptable outcome (70% excellent and 26.7% good). Patients treated with MIPO technique healed earlier and more frequently had excellent results than those treated with ORIF. A total of four patients had complications (knee joint stiffness in 1, postoperative loss of reduction in 1, infection in 1 and knee instability in 1).

Conclusions: Locking compression plate system acts as a good biological fixation for proximal tibial fractures even in difficult fracture situations. MIPO technique offers faster healing and better outcome than ORIF in patients with proximal tibial fractures.

Keywords: Proximal tibial fracture, Locking compression plate, Minimally invasive plate osteosynthesis, Open reduction and internal fixation

INTRODUCTION

The knee joint is one of three major weight bearing joints in the lower extremity. The proximal tibial fractures are one of the commonest intra-articular fractures. Generally these injuries fall into two broad categories, high energy fractures and low energy fractures.

The majority of tibial plateau fractures are secondary to high speed velocity accidents and fall from height where fractures result from direct axial compression, usually

with a valgus (more common) or varus moment and indirect shear forces.^{1,2} Extra-articular fractures of the proximal tibia usually secondary to direct bending forces applied to the metadiaphyseal region of the upper leg. Older patients with osteopenic bone are more likely to sustain depression type fracture because their subchondral bone is less likely to resist axial directed loads.³

The aim of surgical treatment of proximal tibial fracture is to restore congruent articular surfaces of the tibial condyles maintaining the mechanical axis and restoring

ligamentous stability eventually achieving functional knee joint with painless and good range of motion.⁴

The various clinical studies established that bone beneath a rigid conventional plate are thin and atrophic which are prone for secondary displacement due to insufficient buttressing and secondary fractures after removal of plate, fracture site take longer period to osteosynthesis due to interruption of vascular supply to bone due to soft tissue and periosteal stripping.

So there was the birth of a new concept of biological fixation using the plates, otherwise called minimally invasive plate osteosynthesis (MIPO). But this was difficult as conventional plates needed to be accurately contoured to achieve good fixation; osteoporosis also posed the same problem of poor fixation with conventional plates.⁵

This leads to the development of the internal fixators. Point contact-fix I later PC fix II. As more and more concepts about biological fixation become clearer the innovation of plates progressed lead to development of less invasive stabilizing system (LISS). Research to combine these two methods has led to the development of the AO locking compression plate (LCP).⁶ This new system is technically mature and as it offers numerous fixation possibilities and has proven to worth in complex fracture situations and in osteoporotic bones. Hence, we conducted this study to analyse the duration of union and functional outcome in proximal tibial fractures treated with LCP.

METHODS

The study was carried out in Vydehi institute of medical sciences and research center, Bangalore from 2009 to 2011. Adult (≥ 18 years) males and females with proximal tibial fracture presenting to the department of Orthopaedics were included in the study. Patients with type II and III compound fractures were excluded from the study.

At presentation patients were haemodynamically stabilised. Demographic data was recorded and thorough history and clinical examination was done. We assessed the soft tissue injuries even in the closed fractures followed by radiological assessment of the fracture using Schatzker's classification. Patients were checked for associated fractures. Fractures were reduced with traction in fracture table with C-arm guidance. Antibiotics were initiated and continued till the removal of suture. Preoperative planning for selection of plate (MIPO technique vs. open reduction and internal fixation, ORIF) was performed. We treated 23 patients with MIPO and seven patients with ORIF. The approach was either anteromedial or anterolateral incision.

The primary difference with the locking compression plate is the method of locking head screw insertion. Here

since the locking head of the screw has to get locked in the locking part of the combi hole. The direction of the drilling has to be perfect. Hence drilling for all locking head screws has to be after fixing the screw in drill sleeve. We also made sure that whenever using the nonlocking regular screw in the fixation, they were inserted prior to the insertion of the locking screws.

In the immediate postoperative period, care was given to the general condition, fluid balance, IV antibiotic and analgesics as per the protocol. This helped us to mobilize the patient faster. Once the stable internal fixation was achieved, the patient was mobilized after 48 hours after removal of the drains; for initial 2-3 days the range of motion allowed was 0-20° and from the 5th day the range of motion was gradually allowed to increase up to 90° or more and after suture removal full range of movement was allowed.

Whenever there was doubt about the stable fixation, external splinting in the form of plaster of Paris slab was given for support and advised to do static quadriceps exercises. Continue passive motion exercise (CPM) was done daily with temporary removal of slab under careful supervision. Partial weight bearing was delayed until 6 weeks and full weight bearing was allowed after 12-16 weeks.

The first follow up was between 4-6 weeks and later on patients were followed up at regular interval of 4-6 weeks till complete fracture union. During follow up the course of fracture healing was documented radiologically at 6 weeks intervals. Once complete healing was achieved (defined radiologically as complete bone regeneration at fracture site), patients were evaluated for loss of reduction and complications. Clinical outcome was assessed by modified Hohl and Luck evaluation method.

The data was analysed using SPSS Version 19.0; IBM, SPSS Inc., Chicago, IL, USA. Continuous variables are expressed as mean \pm SD and categorical variables are expressed as number and percentages. Chi square test was used to compare categorical variables. A p value less than 0.05 was considered statistically significant.

RESULTS

We studied 30 patients each with unilateral proximal tibial fracture who were treated with locking compression plate. Demographic and clinical characteristics of the study population are summarised in Table 1.

Associated fractures were observed in three patients. One had ipsilateral anterior cruciate ligament injury, one had ipsilateral patella fracture whereas another had fracture of both bones of ipsilateral forearm.

Twenty three patients underwent reduction and fixation by MIPO whereas in seven patients fractures were reduced and fixed by ORIF. Anteromedial approach was

used in 17 patients with medial condylar displacement where MIPO technique was used for reduction and fixation. Anterolateral approach was used in 13 patients with lateral condylar displacement fracture and soft tissue injury on medial side of proximal tibia.

Table 1: Demographic and clinical characteristics of the study population.

Characteristics	No. of patients
Age (years)	35.7±10.2 (range: 20-55)
Male:female	25:5
Proximal tibial fracture right:left	19:11
Fall from height:RTA	9:21
Type of fracture	N (%)
I	5 (16.6)
IV	8 (26.6)
V	6 (20)
VI	10 (33.3)

Table 2: Outcome of proximal tibial fractures treated with locking compression device.

Outcome	No. of patients (%)
Time for complete union of fracture	
>16	4 (13.3)
12-16	24 (80)
<12	2 (6.7)
Range of motion at the operated knee joint	
>120	20 (66.7)
90-120	7 (23.3)
<90	3 (10)
Clinical outcome	
Excellent	21 (70)
Good	8 (26.7)
Fair	1 (3.33)

Table 3: Comparison of outcome in proximal tibial fracture patients treated with MIPO and ORIF techniques.

Outcome	Total (%)	MIPO	ORIF	P value
Range of motion at the operated knee joint				
>120	20 (66.7)	18	2	0.003
90-120	7 (23.3)	5	2	
<90	3 (10)	0	3	
Clinical outcome				
Excellent	21 (70)	19	2	0.013
Good	8 (26.7)	4	4	
Fair	1 (3.33)	0	1	

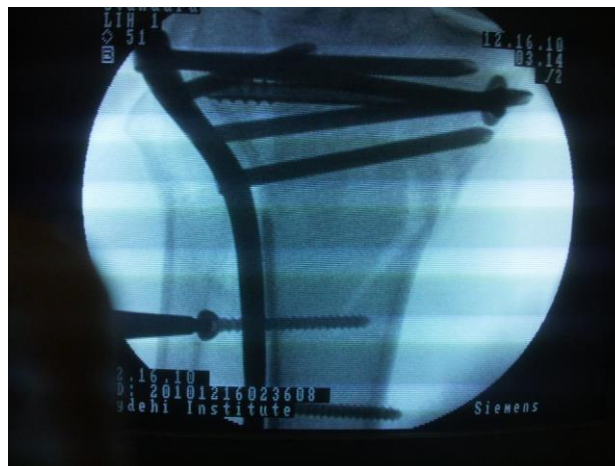


Figure 1: C-ARM images per operative.

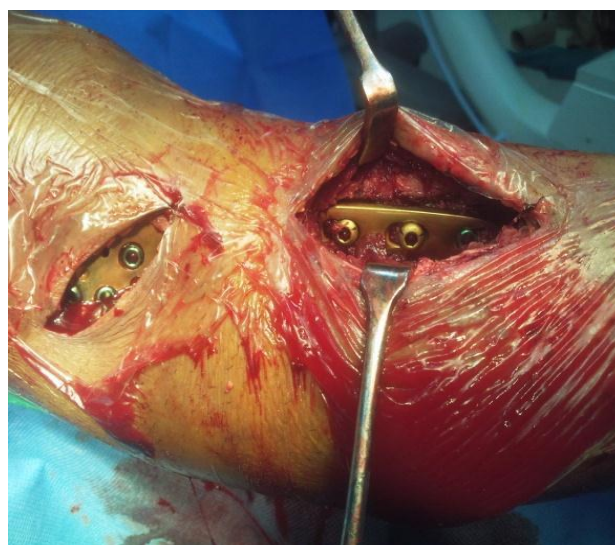


Figure 2: Peroperative photograph -MIPO

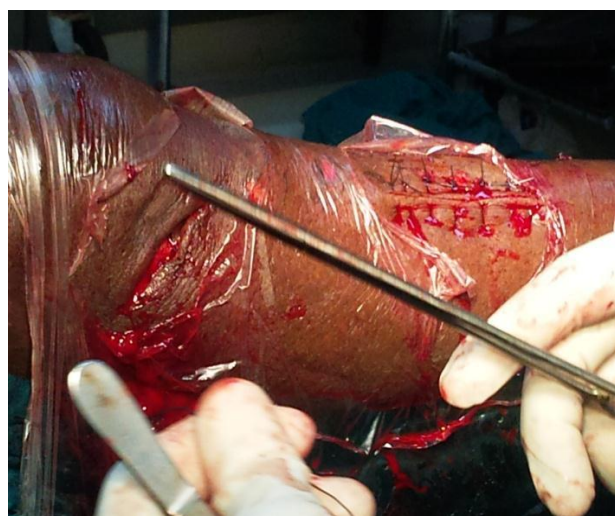


Figure 3: Peroperative photograph -MIPO.

In the overall cohort mean duration for wound healing was 14 ± 1.68 weeks. Overall 90% of patients had >90 degrees range of motion and 96.7% patients had acceptable outcome (70% excellent and 26.7% good) (Table 2). Duration of wound healing was shorter (13.6 ± 1.46 vs. 15.5 ± 2.1 weeks, $p=0.045$) in patients who underwent reduction and fixation by MIPO technique than those who underwent ORIF technique. Range of motion at operated knee joint was >90 degree in 90% of subjects and larger proportion of patients who underwent reduction and fixation by MIPO had higher range of motion ($p=0.003$, Table 3). Good or excellent outcome was obtained in 96.7% of patients with larger proportion of patients who underwent MIPO technique had more frequent excellent results ($p=0.013$, Table 3).

In our series 26 patients had no complication. In our series we had no cases of any purely implant related complications. One patient developed knee stiffness due to patella fracture treated with patellectomy and physiotherapy and regained 70° of flexion. Another patient presented with knee joint instability at end of 6 months of postoperative period. He was treated with ACL reconstruction and physiotherapy and subsequently he regained a range of movement from complete extension to 90° of flexion. One patient developed deep infection by 7th postoperative day secondary to uncontrolled diabetes and skin infection in thigh region, he was treated with intravenous antibiotics (ceftriaxone and amikacin), implant removal and above knee POP cast application. Subsequently infection was controlled and fracture union occurred at an end of 24 weeks postoperatively. Another patient developed loss of reduction with collapse of medial condyle at end of 8 weeks of postoperative period treated with above knee POP cast for 12 weeks. Subsequently fracture united with minimal depression of medial condyle.

Associated injuries were managed appropriately. Ipsilateral patella fracture was treated with total patellectomy. Both bone fracture forearm was treated with ORIF using plate and screws. One patient with ACL injury underwent ACL reconstruction after 6 months of the definitive fracture surgery.

DISCUSSION

Proximal tibial fractures are one of the commonest intraarticular fractures and incidences of these fractures are increasing regularly due to RTA. At the same time surgical treatment options for the same are also being modified continuously. Any fracture around the weight bearing joint like knee joint is of paramount importance as it would result in significant morbidity and reduced quality of life. Hence the treatment of proximal tibial fractures has become a challenge for the orthopaedic surgeons. To overcome these difficulties and to early restoration of strength of bone and function of knee joint with minimal injury to soft tissue the innovators

developed new technologies called MIPO and locking compression plate system.

Keeping our aims of the study at high, we presented the clinical study of surgical treatment of 30 proximal tibial fractures. The majority (63.3%) of fractures occurred in the productive age group 20-40 years with the mean age of the study population of 35.7 ± 10.2 years. Previous studies have reported similarly with the mean ages of 38.5 years and 39.8 years.^{7,8} In our series majority of the patients were males (80%), which can be attributed to our Indian setup where the female population largely work indoor and do not travel much. This is similar to that reported by Sidharthan et al, where males were more prone.⁹ In our study the commonest mode of injury being the road traffic accident (70%), most of the patients had type IV, type V and type VI Schatzker's fracture types which are usually associated with high velocity RTA.

We used MIPO technique for reduction and fixation in 23 (76.6%) patients. Although not exactly quantified we appreciated shorter duration of procedure, less blood loss and less soft tissue injuries with MIPO than ORIF technique. Moreover, wound healing was better and faster, a larger proportion of patients had range of motion >120 degrees and had excellent clinical outcome with MIPO when compared to ORIF technique. However, MIPO demanded more surgical techniques.

In our series anteromedial incision was used in 17 patients; this approach needs less soft tissue stripping from bone, can contour plate to bone appropriately and easy to perform MIPO technique. Anterolateral approach was preferred in patients ($n=13$) with lateral condylar displacement fracture and soft tissue injury on medial side of proximal tibia.

Complications were few (13.33%) in our study cohort and we achieved excellent result in 70% and good result in 26.7% (overall 96.7%, acceptable results) of patients. These results are comparable with that reported by previous studies (85%).^{8,10}

CONCLUSION

To conclude, locking compression plate system acts as a good biological fixation for proximal tibial fractures even in difficult fracture situations. MIPO technique offers faster healing and better outcome than ORIF in patients with proximal tibial fractures.

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