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Functional Outcome Of Minimally Invasive Plate Osteosynthesis (Mipo) In Proximal Tibial Fractures – A Hospital Based Prospective Cohort Study

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ABSTRACT:

Background:

A hospital based prospective cohort study was done to evaluate the results of proximal tibia fractures managed with minimally invasive plate osteosynthesis (MIPO) and assessed for time for bony union, functional outcome and complications of the said procedure.

Methods: A one-year hospital based prospective cohort study was conducted; which included a total of 30 patients who presented to the Emergency Department, OPD/IPD of the Department of Orthopaedics and met the inclusion criteria which were enlisted in the study. The functional outcome of Minimally Invasive Plate osteosynthesis (MIPO) using locking and non-locking compression plates in tibial condyle fractures were evaluated. The data was compiled & analysed using Sanders 40 Point.

Results: Fractures of proximal tibia were more prevalent in the younger and middle-aged population with mean age range 21-60 years. All the 30 fractures analysed were graded in accordance to the schatzker classification with 16 cases of type 1, 5 cases of type 2, 4 cases of type 3, 2 cases of type 4, 1 case of type 5 and 2 cases of type 6 fractures. In our study Males were more commonly affected than females (24 males and 6 females). About 70% of the fractures were due to high velocity trauma. In Schatzker type 5 and 6 fractures MIPO technique did not show good results and thus dual plating was done in 2 (6.67%) cases. The mean time to union was 14.6 weeks, with 54% of fractures uniting in 14 – 16 weeks. Complication in the form of infection was observed in 2 (6.67%) cases. There were 2 (6.67%) cases of collapse of the reduced fracture and 2(6.67%) cases of malunion. In type 5 and type 6 fractures MIPO alone was insufficient and we observed that these fractures required dual plating. Sanders's score was applied to analyze the functional outcome of our cases. After evaluation it was observed that 83% of patients had good to excellent performance. Four patients had fair results and one performed poorly. The average range of motion of the knee joint was 0° to 120°.

Conclusion: Minimally Invasive Plate Osteosynthesis (MIPO) is a good technique to stabilize the fractures of the proximal tibia (Intra Articular) with minimal soft tissue dissection, preservation of the fracture haematoma and early range of motion, thus facilitating patients in early recovery and active participation in rehabilitation programme.

KEYWORDS: Proximal tibia, MIPO, Schatzker classification, Sanders's score, compression plates.

INTRODUCTION:

Intra articular fractures of the proximal tibia involves a major weight bearing joint which if not managed well, result in functional impairment. These fractures make up 1% of all fractures. Most of the injuries in 55-70% cases affect the lateral condyle. Isolated injuries to the medial condyle occur in 10-23% cases; whereas bicondylar fractures are seen in 10-30% cases. [1]

High energy complex tibial condyle fractures being intra-articular are usually associated with injury to ligaments, capsule and other soft tissues around the joint. They present multifaceted difficulties in achieving accurate joint reconstruction. Wedge failure, wedge depression and pure depression type failures are typical of the lower energy spectra.[2]

Various classification systems are available for classifying these fractures including Schatzker classification system and AO classification. The Schatzker classification system for proximal tibia fractures, which divides these fractures into six types, is widely recognized by orthopaedic surgeons to assess the initial injury, plan management and predict prognosis.[3]
In anteroposterior (AP) / lateral and oblique radiographs the standard pre-operative evaluation is done. Tomograms or additional traction views may be obtained to aid the assessment of comminution, depression and true condylar widening. CT scans and MRI are used where ever necessary.
The objective of management of these fractures has been controversial. Stable, pain free knee joint with a functional range of motion has eluded most of the treatment modalities. Non-operative procedures like cast, braces or traction are complicated by intrinsic risks of poor functional results and extended hospital stay.[4]
The proximal tibial fractures are particularly difficult in assessing, the operative management. Open reduction and internal fixation haave its own complications. Middle path of minimally invasive technique of closed reduction by ligamentotaxis and stabilizing the fracture by limited internal fixation is being developed. This utilizes percutaneous screws and K-wires, external fixation frames or combination of external fixation with some degree of internal fixation to stabilize tibial condyle fractures. The minimally invasive technique attributes to operative and non-operative philosophies as it gives outstanding functional results. [4]
With the use of MIPO technique unilateral fixation of the condyles is possible as well as there is minimal handling of the soft tissue which further helps in achieving a good functional outcome. [5]
As a general rule there is no fixed treatment method that can be used routinely for all fractures, as each patient must be evaluated and treated as individual case. Although the initial results in patients with variety of fractures with locking plates are encouraging, it is increasingly evident that failures do occur. In this study we would like to evaluate the functional outcome of proximal tibial fractures treated with Minimally Invasive Plate Osteosynthesis (MIPO).

MATERIAL & METHODS:
This is a one-year hospital based prospective cohort study. A total of 30 patients were enrolled in the study as per eligibility criteria. Data was collected from all patients who presented to the Emergency department, OPD/IPD of the Department of Orthopaedics, KLES Dr Prabhakar Kore Hospital and MRC Belagavi from 1st Jan 2016 till 31st Dec 2016. The written informed consent was obtained from the study participants. The institutional committee approved.
Patients who had previous or existing infection in the involved leg, compound fractures with extensive soft tissue damage where plate cannot be covered with soft tissue, pathological fractures other than osteoporosis and patients with neurovascular deficits were excluded from the study.
Study Protocol: A complete and thorough examination of the patients along with the associated injuries were performed in the emergency room. The neurological and vascular status of the involved limb were assessed. The necessary x-rays were obtained and evaluated. CT Scans were obtained whenever required to confirm the type of fracture and to plan the operative procedures. The surgical approach to complex tibial plateau fractures was individualized on the basis of particular fracture configuration and minimal access Anterolateral standard approach was used. [6]
The patients were regularly followed-up on OPD basis up to 9 months and were assessed both clinically and radiologically. Patients were allowed toe-touch partial weight bearing from one month of surgery and full weight bearing thereafter on the subsequent follow-ups. All long-term complications like non-union, mal union, angular deformity, implant breakage, shortening or infection were recorded.

Study Parameters:
1. Clinical Parameters
- Pain: The pain perception by the patients was assessed by Sanders 40-point functional evaluation scale Radiological Parameters
- Walking :

2. Radiological Parameters:
The final result was based on the functional and radiological outcome. The outcome was evaluated on the basis of **Sanders 40-point functional evaluation scale**.

RESULTS:

Table 1: Age Distribution of the Study Participants

Age (years)	No.	% age
20-30	3	10
31-40	10	33.33
41-50	5	16.67
51-60	9	30
>60	3	10

The study was carried out for 30 patients with a mean age of 45 years (range 20-60 years). Out of 30 patients 24 were males (80%) and 6 females (20%). All the 30 (100%) fractures studied were closed fractures. Out of the 30 cases 25 (83.33%) of the fractures were due to road traffic accidents and 5 (16.67%) of the fractures were due to fall from height. Out of the 30 patients studied 18 (60%) had isolated proximal tibia fractures, 2 (6.67%) had associated head injury, 5 (16.66%) had associated blunt trauma to the chest, 3 (10%) had blunt trauma to the abdomen and 2 (6.67%) had neurological injury.

Table 2 – Pain Perception among Study Participants

Pain	No. of Patients	%
None	13	43.33
Occasional	10	33.33
In-certain Positions	5	16.67
After Activity	2	6.67
Night Pain	-	-

Sanders 40-point functional evaluation scale in the present study was applied to analyse the functional outcome among the cases. Pain, range of motion at the knee, walking capacity, residual extension lag and stability were the criteria which determined the final outcome.

Out of the 30 patients evaluated 13 (43.33%) had no pain, 10 (33.33%) had occasional pain, 5 (16.67%) had pain only in certain positions, 2 (6.67%) had pain only after some activity and none had night pain.

Table 3 - Assessment of Walking Capacity among study participants

Walking Capacity	No. of patients	%
Normal	18	60
At Least 1 Hour	7	23.33
At Least 15 Min	4	13.33
Indoors Only	0	-
Wheel Chair / Bed Ridden	1	3.33

On evaluating the walking capacity of the 30 patients; 18 (60%) had normal walking capacity, 7 (23.33%) could walk for at least 1 hour, 4 (13.33%) could walk for at least 15 minutes and 1 (3.33%) patient was wheel chair / bed ridden.

Table 4 – Assessment of Extension Lag among Study Participants

Extension Lag	No. of Patients	%
Normal (0 Degree)	23	76.67
Extension (0-10 Degree)	6	20
>10 Degree	1	3.33

On evaluation of post-operative Extension at the knee joint, we found that 23 (76.67%) patients had normal extension, 6 (20%) patients had an extension lag between 0 – 10 degrees and 1 (3.33%) patient had an extension lag of more than 10 degrees.

Table 5 – Assessment of Range of Motion among study participants

Flexion	No of Patients	%
At Least 140 Degree	16	53.33
120 Degree	12	40
90 Degree	2	6.67
60 Degree	-	-
30 Degree	-	-
0 Degree	-	-

On evaluation of post-operative Flexion at the knee joint, we found that 16 (53.33%) patients had at least 140 degrees of flexion, 12 (40%) patients had 120 degrees of flexion and 2 (6.67%) patients had 90 degrees of knee flexion.

Table 6 - Final Score

Score	Results	No. of patients	%age
27-30	Excellent	19	63.33
20-26	Good	6	20
10-19	Fair	4	13.33
<10	Poor	1	3.33

After evaluation, it was observed that 85% of patients had good to excellent performance (Excellent - 19 patients; good - 6 patients). 4 had fair results and 1 performed poorly. The average range of motion in our study was 0(range 0-15°) to 120° (range 60 - 140°).

DISCUSSION

The fractures of the proximal tibia are high energy injuries most commonly due to road traffic accidents associated with other skeletal, ligamentous and multi system injuries. The results of treatment of these injuries have often been poor with loss of motion, instability, posttraumatic osteoarthritis, wound breakdown and infection as final outcomes, but with proper interventions and good surgical techniques, these injuries had better results. [2,7,8]

In the present study, we had final follow up of 30 patients.

Age and Sex incidence

In this study it was observed that fractures of proximal tibia were more prevalent in younger and middle-aged population with the mean age being 40 (range 21-50 years). Males were more commonly affected than females (24: 6).

In the study by Tul B Pun et al (2014)[9], the mean age of the patients was 43.85 years (range 22 – 61 years). There were 20 male patients and 1 female.

The mean age of the patients was 41.4 years (range 19-83). In the study by R. Jiang et al (2008)[10]. There were 29 males and 12 females in the same study.

In another study by P Phisitkul et al[11], (2007) the study included 22 male and 15 females aged between 22 and 71 years (mean age of 45 years).

In a study by Zura RD et al (2010)[12] there were 78 patients with an average age of 43 years (range 14 to 81 years). Which included 59 male patients and 19 female patients.

Hence, we conclude that the fractures of proximal tibia were found to be common in younger and middle-aged population. Since this age group is involved in more outdoor activities.

Mode of Injury:

In our study of 30 cases 83.33% of fractures were due to Road Traffic Accidents and 16.67% fractures were due to fall from height.

In the study by Hak DJ et al (2010)[13], the cause of the injury was due to high energy trauma with 40% patients were pedestrians hit by a motor vehicle and 40% patients were fall from height and 4% were due to sports injury and remaining were due to motor cycle collision.
In the study by P Phisitkul et al, (2007)[11] 15 patients sustained fracture after fall from height, 17 patients through RTA. 2 patients in crush injury and 1 patient during fight.
In the study by GT Prasad et al (2013)[14] 23 cases were pedestrians hit by two wheelers, 8 cases were fall from two-wheeler, 9 cases were accidents due to four wheelers.
Thus, proximal tibial fractures are more common after high energy trauma especially motor vehicular accidents.

Fracture type and grade:
All the 30 fractures analysed in this study were graded in accordance to the Schatzker classification. It was observed that 16(53.33%) were type I. The next common being type II 5(16.67%) and type III 4(13.33%). This signified that majority of fractures in this study had intra-articular fractures. Higher grade of these fractures was attributed to high velocity trauma.
Hak DJ et al (2010)[13] have used the Schatzker classification to classify the fractures in their study.
In another study by Rademakers et al (2007)[15] 70 patients had fracture of the lateral condyle (Schatzker I/II/III) and 7 had fracture of medial condyle (Schatzker IV). Fourteen (14%) had Schatzker type VI fracture.

Hospital Stay:
In our study 70% of the patients returned home in a weeks' time. Majority of the patients had a hospital stay of less than 2 weeks with average being 12 days.
In a study done by GT Prasad et al (2013)[14] the hospital stay of the patients varied from 5 to 14 days with a mean of 6 days.

Associated injuries:
Out of the 30 cases analysed in this study, 18(60%) had isolated proximal tibia fractures. The association of blunt trauma, chest 5(16.66%), abdomen 3(10%) was another important finding.
In a study by Lee et al (2007)[16] associated injuries like pneumothorax and rib fractures were present in 5 patients.
In another study 39 patients had multiple fractures and 163 patients had isolated fractures, Rademakers et al (2007)[15]
In the study by Egol et al (2004)[17], 10 of the 38 patients sustained associated fractures.
In a study there were 10 cases of poly traumatized patients and 12 cases of mono-trauma, by Schutz et al (2003)[18].
Since patients of Road Traffic Accidents are often associated with multiple injuries hence a thorough assessment is necessary.

Fracture union:
Clinical union was defined as a painless fracture site during full weight – bearing and radiographic union as bridging trabeculation across the fracture lines on three of four cortices seen on orthogonal projection in the absence of migration, loosening, or breakage of hardware by Haidukewych et al (2008)[19].
In our study, on the basis of radiological and clinical examination average time to union was calculated to be 17.6 weeks. In almost 50% of cases fracture united in 14-16 weeks.
Study by R. Jiang et al (2008)[10] showed union in 41 fractures at a mean age of 14.1 weeks.
In a study by Rademakers MV et al (2007)[15] 95% patients had a fracture union at 16 weeks.
In the study by Tul BP (2014)[9] the patients started walking with support at an average time period of 5.86 months from day of surgery, (range 4 to 7 months).
In this study, 47 of 52 fractures showed union and one bicondylar fracture went into delayed union which too healed at nine months by Haidukewych et al (2008)[19]
Thus, in our study rate of union of the fractures was similar with other studies.

Complications:
A. Early complications
Infection:

In our study, due to the head injuries the surgery was delayed in two patients i.e 6.67%. Thus, stressing on the need of careful pre-operative examination of the neuro-vascular status of these patients. This also signifies the severity of the trauma in such fractures.
In this study we had complications in two cases. One of these patients had superficial infection which was treated with intravenous antibiotics and the other case had wound gaping at the suture line which was treated with debridement and re- suturing. This can be attributed to the wound management protocol in emergency department in conjunction with radical debridement with skillful handling of soft tissues and perioperative antibiotic coverage.
A study done by Zura RD et al (2010)[12] 7 patients developed infection out of which 5 were deep infection and 2 developed superficial infection.
In the study by Lee et al[16], deep infection developed in two patients (8%) and developed wound drainage after seven days of surgery.
In the study by Stannard et al[20] the incidence of infection for all fractures was 5.9% with two superficial infections.
In the study by P Phisitkul et al, (2007)[11] there were 8 cases with deep infection, 1 case with superficial wound dehiscence, 2 cases were of loss of alignment.
In a study by Rademakers MV et al (2007)[15] 11 patients developed deep infection within 1st two weeks of treatment and were treated with debridement.
Thus, we can conclude that with skillful soft tissue handling a use of pre-operative, intra-operative, post-operative broad-spectrum antibiotics the incidence of infection was found to be less in our study.

B. Late complication
In our study, collapse of the reduced fracture was observed in two patients (6.67%). These were polytrauma patients who had significant associated injuries in the form of head, chest and abdominal injuries. Thus, the collapse was attributed to the poor compliance of the patient.

We also observed that fractures of type V and VI went into malunion when treated with MIPO and required dual plating.
In study by Rademakers MV (2007)[15] 4% of the patients developed malunion.
In the study by Schutz et al there were three cases, with malalignment greater than 5 degree.
In a study by Hak DJ (2010)[13] Schatzker type V and type VI fractures were the most common in the fasciotomy group and which later went on to malunite.

Functional outcome:
In the present study, Sanders 40-point functional evaluation scale in the present study was applied to analyse the functional outcome among the cases. Pain, range of motion at the knee, walking capacity, residual extension lag and stability were the criteria which determined the final outcome. After evaluation, it was observed that 85% of patients had good to excellent performance (Excellent - 19 patients; good - 6 patients). 4 had fair results and 1 performed poorly. The average range of motion in our study was 0(range 0-15°) to 120° (range 60 - 140°).
Tul B Pun et al (2014)[9] the functional outcome score was good in 13 patients, fair in 7 patients and poor in 1 patient. The average knee range of motion was 128.09° and range of motion varied from 90 to 140°. There were 2 patients with flexion less than 110°.
Due to the damage to the extensor retinaculum or the joint surface or as a result of surgical exposure to fix the fracture there is scarring of the extensor mechanism with or without arthrofibrosis of the knee or patellofemoral joint which can lead to restriction of the movements at the knee joints. Immobilization or internal fixation greatly magnify these effects. Early stable fixation of the fracture, meticulous dissection of the soft-tissues, with minimal exposure and immediate mobilization of the knee joint maximize the chances of good functional outcome.

CONCLUSION:
Minimally Invasive Plate Osteosynthesis is a good technique to stabilize the fractures of the proximal tibia (Intra Articular) with minimal soft tissue dissection, preservation of the fracture haematoma and early range of motion, thus facilitating patients in early recovery and active participation in rehabilitation programme.

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