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Comparative analysis of closed reduction and expert tibia nailing and open reduction and plate & screw fixation in the treatment of proximal tibia extraarticular fractures

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Abstract

Introduction: Extra-articular proximal tibial fractures account for 5–10 % of all tibial shaft fractures and it result from high-velocity trauma. Closed reduction with minimally invasive plating and locked intramedullary nailing have been widely used for treatment of proximal tibia extraarticular fractures. Our pupose is to compare the pros and cons of these two methods.

Materials and Methods: 22 patients were included in this study for a period of 2 years. Patients treated with IMN were kept in group A patients treated with percutaneous plating were kept in group B. Standard approach of nailing and plating were used and proper follow up were taken for next upcoming 1 year.

Results: Combined average age was 38years. Male were more commonly affected than female (13:8). Majority of fracture were of type A33. Operative time was < 2 hours in both groups. Less blood loss occurred during intramedullary nailing as compared to locking plate fixation. Surgical site infections (SSIs) were seen in two patients in the PTP group. Delayed union occurred in two patients in the IMN group. The average range of motion was 119.7(range 90-150, SD= 19.18) in group A and 115.2(range 80-150, SD = 17.28) in group B.

Conclusion: In treatment of proximal tibia extra articular fracture use of IMN and PTLCP gives comparable results. To validate this issue further a large sample size multicentric study is recommended.

Keywords: Intramedullary nailing (IMN), extraarticular tibialn fracture, surgical site infection

Introduction

Extra-articular proximal tibial fractures account for 5–10 % of all tibial shaft fractures ^[1, 2] and It result from high-velocity trauma. They lead to complex tissue injuries of bone and surrounding soft tissues ^[1]. If Conservative management of these fractures has resulted in malunion, nonunion, rotational deformity, or stiffness of adjacent joints ^[3, 4]. So there has shift towards operative management of these fractures in recent times. However, surgically treating these fractures remains debatable. Options include half-pin external fixation, intramedullary implant, hybrid or thin-wire external fixation, plate fixation, or a combination of these techniques ^[5].

In recent years, closed reduction with minimally invasive plating and locked intramedullary nailing have both become widely used treatment modalities for proximal tibia extraarticular fractures ^[7, 8]. We design to this study intended to compare these options in terms of operative time, duration of hospital stay, period of non-weight bearing, degree of reduction, union rate, malunion rate, infection rate, and rates of other possible complications which could possibly affect decision-making in relation to such fracture patterns.

Materials and Methods

22 patient of Gandhi Medical College and Hamidia Hospital Bhopal were included in this study during the study period of 2 years. Patients were followed up for 1year, evaluated radiologically and clinically with Tegnerlysholm knee scale, t outcomes were used for comparison. Skeletally matured (age group 18-65 years) having closed Proximal one third tibia extraarticular fracture (defined as roughly to proximal 30% of the entire tibia.)

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Were included in this study. Intraarticular fracture, pathological fracture, fracture with vascular complications were excluded.

Group a patients were treated with IMN and group B patients received percutaneous tibia plating. In group A the patient was positioned supine on the operation table. Temporary anatomical reduction was achieved by closed manipulation before nailing. An incision by splitting patellar tendon extending from lower pole of patella to tibial tuberosity was used to open the joint. Antero-posterior or medio-lateral blocking screws were also used only in few cases. The surgical wound closure was done in layers. The intramedullary nail had a proximal Herzog band and four multilevel, multiplanar, and multidirectional screws (Fig 1). In group B using curvilinear incision over the lateral aspect of the proximal tibia. Indirect reduction was achieved using axial traction and/or the application of a reduction clamp or distractor. Internal fixation was then achieved with a proximal tibial lateral locking compression plate (LCP). A minimum of three screws were used on both sides of the fracture, and plating was done using a minimally invasive technique (Fig.

2).

Postoperatively, patients of both groups were given i.v third generation cephalosporins for 5days. Ankle pumps and isometric quadriceps strengthening exercises were started on the first postoperative day, followed by active and assisted knee bending and partial weight bearing started on the second Postoperative day depend on stability construct whereas full weight-bearing was allowed after complete clinical and radiological union. Patients were followed up at 2 and 6 weeks, 3 and 6 months, and 1 year postoperatively.

Both the immediate postoperative and the final follow-up radiographs compared to assess the accuracy of reduction and final alignment. Measurements for coronal (varus and valgus) and sagittal (procurvatum and recurvatum) plane deformities using technique described by Freedman and Johnson [10]. In AP view, varus/valgus deformity evaluated by measuring the angle between the lines drawn perpendicular to the proximal and distal tibial articular surfaces. In lateral view, the procurvatum/recurvatum was measured similarly and 8 degree of posterior slope was subtracted. Malreduction was defined as a deformity of 5degree in any plane.

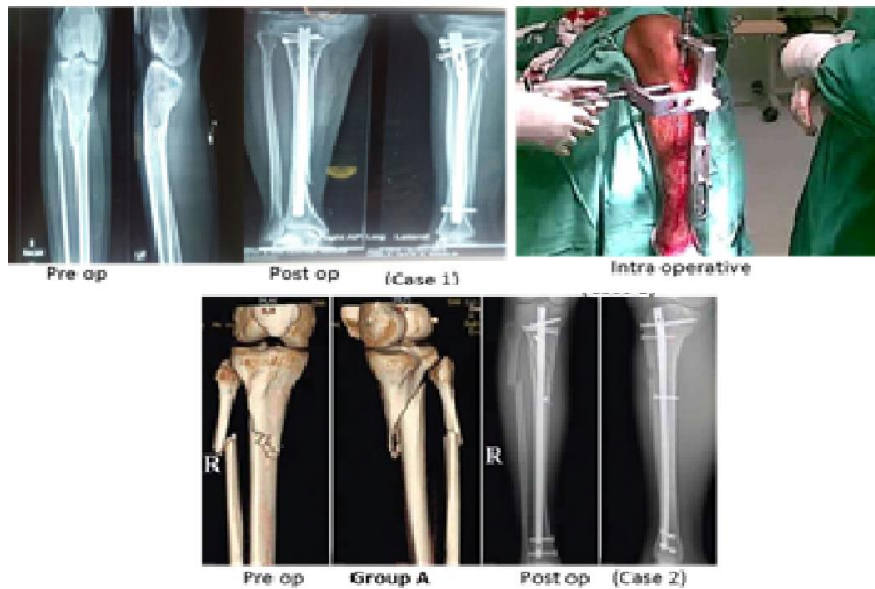


Fig 1: Pre-Operative, Intraoperative and post-operative pic of group “A”





Fig 2: Pre-Operative, Intra operative and post-operative pic of group “B”

Out of a total of 22 patients, 01 (1 in the plating group) were excluded from the study as they were absent for follow-up, meaning that 21 patients were included in the final outcome analysis.

Table 1: Baseline data of 21 patients

Parameter	N
Injury cause	
Car accident	8
Falling down	6
Fall from height	5
Others	2
Fracture type	
Open	5
Close	16
Combine injury	
Clavicle fracture	2
Rib fracture	1
Humerus fracture	0

All data were entered into a proforma. A statistical analysis was performed by using the Statistical Package. The parameters were compared between the groups

Table 2: Comparison of the demographic and postoperative data for both groups

Parameter	Group A	Group B
Age (Average)	39 year (19-65)	36 year (19-62)
Sex		
Male	8	5
Female	6	2
Mode of trauma		
Road traffic accident	5	3
Fall from hight	3	2
Falling down	4	2
Other	2	0
Fracture type extraarticular		
41A2	3	5
41A3	8	5
Injury operation interval (in days)	7.4	7.06
Average operative time (in minutes)	61.25	72.8
Open reduction	None	47%
Blood loss (average)	50-100ml	100-200ml
Infection	1	2
Nonunion	1	0
Duration of hospital stay	4.1(2-8)	5.3(3-10)
Union time (Weeks)	18.26(10-30)	22.84(16-34)
Range of motion of knee	119.7(90-150)	115.2(80-150)
Distribution of malunion	2	0
Anterior angulation	0	0
Posterior angulation	0	0
Valgus malunion	1	1
Varus malunion		

Results

Extraarticular proximal tibial fracture was more common in age group between 19 to 65 years with the combined average age was 38years. Male was more commonly affected than female and M: F ratio was 13:8. Young male are more involve in outside, productive, high energy activities so male more compatible suffer from this fracture. In both the group road traffic accident followed by fall from height was the two most common mode of trauma.

Classification of fracture: majority of fracture were of type A33, significant Comminution was present in these type of fractures.

Duration after injury, Most of the cases in both the group were operated within ten days of injury.

Operating time, in most of the cases 96.77% (60/62) operative time is < 2 hours. One case in each group required more than 2 hour. According to data, PTLCP fixation takes more time than intramedullary fixation.

Blood loss, There was no heavy blood loss in any of the case, because all the fixations are done under tourniquet. Less blood loss occurred during intramedullary nailing as compared to locking plate fixation.

Postoperative hospital stay, time period to full weight bearing, and union time were significantly less in the IMN group as compared to the PTP group (Table 2).

Surgical site infections (SSIs) were seen in two patients in the PTP group, one of which was resolved with debridement while the other necessitated implant removal due to infection.

Delayed union occurred in two patients in the IMN group, for which dynamization was performed by removing the distal screw.

Nonunion occurred in one case in the nailing group presented which ultimately required exchange nailing with bone grafting and fibular osteotomy. There was nonunion in one patient in the PTP group; bone grafting was done in that case, which eventually led to fracture healing.

Malalignment was seen in three patients (21.1 %) in the IMN group (one patient had varus and two had anterior apex deformity) and in one patients (16 %) in the PTP group (varus malalignment). Observe in immediate postoperative and 1-year follow up Xray

The average range of motion was 119.7(range 90-150, SD= 19.18) in group A and 115.2(range 80-150, SD = 17.28) in group B. There were complaints of occasional anterior knee pain and discomfort upon kneeling on the floor from two patients in group A and two patients in group B.

Discussion

Proximal tibia extraarticular fractures often occur in people

belonging to young active age group. In present study, the overall mean age was 38 years (range 19 to 65 years). Schultz M. *et al.* [11] has shown mean age of 42 years in their study. While Cole, *et al.* [12] have shown mean age of 45 years in their study. 90.3% of the patients in present study were male and only 9.7% were females. Thus results of present study were well similar with results of previous studies [11, 12].

In present study, road traffic accident was found to be the major cause of this fracture. In 80.6% of the cases, mode of trauma was road traffic accident and in 16% of the cases, mode of trauma was fall from height while 3.2% of the cases had history of assault by hard and blunt object. Various previous studies have also shown similar distribution of mode of injury [11, 13].

Lindval E. *et al.* [13] have also shown high prevalence of 41A3 in their study. Most common type of fracture observed in

present study was 41A3. 77.41% patients in study had 41A3 type of fracture while rest 22.59% patients had 41A2 type of fracture. 41A3 fractures represent significant comminution which requires a large amount force to occur.

In present study, the average injury operation delay was 7.23 days. In study of Cole *et al.* [9] average, Poor soft tissue condition, associated medical illnesses, associated injuries, feasibility of implant and many other factors were responsible for this delay in fixation in present study.

There is no significant data available in literatures about the duration of surgery for both the treatment modality. In present study, most of the fixations were done within 2 hours. Proximal one third extraarticular fracture often fixed under tourniquet so no significant blood loss occurred intraoperatively.

Table 3: Comparison of Malunion in various study

Study	Extra articular proximal tibia fracture	Malunion (>50 degree)	No. of cases of malunion
Lange <i>et al.</i> [15].	32	23	16-apex ant. 13 valgus(6 with both plane)
Tornetta <i>et al.</i> [17].	30	7	4 apex ant. 3 coronal
Nork <i>et al.</i> [16]	30-33	3	1 Varus
Lindvall <i>et al.</i> [13].	22	9	8 apex anterior 2 valgus
Present Study	14	3	2 anterior angulation 1 varus
Cole <i>et al.</i>	28	08	1 valgus 6 apex ant 1 apex posterior
Ricci <i>et al.</i>	18	05	2 valgus 2 apex ant. 1 apex post
Lindvall <i>et al.</i>	34	07	5 apex anterior with 1 varus 2 apex post.
Vidhyadhar S. <i>et al.</i>	45	07	4 apex anterior, 3 valgus
Present study	7	01	1 varus

In present the pooled rate of malunion was greater after intra-medullary nailing (3/14, 21.4%) than after plating (1/7, 14.28%).

Anterior curvature mal-alignment is encouraged by a tibial plateau that is directed posteriorly between 3° to 7° and also by the pull of the patellar ligament, inserted on to the tibial tuberosity [13].

To avoid this complication in nailing of this type fracture, some specific additional techniques can be used. These include, adjusting the proximal starting point, nailing in semiextended position, using an adjuvant plate and placing blocking screw before nailing.

To avoid malunion complications in PTLCP fixation Oh C.W. *et al.* [18] advised double plating in highly unstable fracture. Bolhofner *et al.* [19] suggested use of composite fixation (lateral plate with medial external fixator) in patient with extraarticular proximal tibia fracture.

In present study only inter fragmentary screws were used as additional technique in 1/7 patients of Group II.

In present study rate of mal union was higher in Group I treated with IMN as compared to the Group II treated with PTP 14.8% (1/7) cases develop malunion in followup. This study reported that malunion is more prevalent in the sagittal plane than the coronal plane for both implants. (3, 4, 10, 11, 12)

Table 4: Comparison of infection rate in various studies

Study	IMN group	PTLCP group
Bhandari <i>et al.</i> [20].	2.5%	14%
Lindvall <i>et al.</i> [13].	28%	24%
Oh C W. <i>et al.</i> [18].	0%	-
Present Study	7.14	28.5

Over all higher rate of infection in PTLCP group may be attributable to large incision, soft tissue damage, shortcomings in addressing these soft tissue injuries, additional co morbidities.

In various studies of extra articular proximal tibia fractures treated with IMN, full weight bearing has ranged from 8-16 weeks depending upon the fracture location, fracture pattern and surgeon preference [13, 5]. Studies often state “weight bearing advanced as tolerated” but this does not accurately define when full weight bearing actually occurred and therefore can't be used to determine if either technique allow for earlier full weight bearing without implant failures.

Unfortunately present study could not document the benefit of either of the treatment modality in this parameter.

Table 5: Comparison of nonunion rate in various studies

Study	IMN	Plate
Bhandari <i>et al.</i> [20].	3.51% (7/199)	1.35% (1/74)
Lindvall <i>et al.</i> [13].	23% (5/22)	6% (2/34)
Present study	7.14%(1/14)	0%(0/7)

Distraction, lack of cortical contact, soft tissue interposition, poor vascular supply, persistent high grade infection or excessive mal alignment at the fracture site may be the causative factors for nonunion after fixation in patients treated with IMN, while soft tissue interposition, persistent deep high grade infection seems to be responsible for nonunion in patients treated with PTLCP. Overall pooled rate of nonunion was low, in intramedullary nailing (1/14) 7.14% and plating (0/7) 0%.

Over all mean union time was 17.15 weeks. Mean union time in Group I was 16.2 weeks (range 14-24 weeks) while mean union time in Group II is 18.1 weeks (range 16-22 weeks).

Conclusion

This prospective comparative study concludes that in treatment of proximal tibia extra articular fracture use of IMN and PTLCP gives comparable results. Use of PTLCP is associated with more intra operative blood loss, higher postoperative infection rate and longer duration of hospital stay whereas use of IMN associated with higher rates of malunion and nonunion. However there is no difference in functional outcome between IMN and PTLCP. To validate this issue further a large sample size multi centric study is recommended. Overall proximal one third extraarticular tibia fracture is complicated and problematic fracture to deal with and is commonly associated with significant soft tissue damage. High grade of surgical skills are required to deal these fractures as fixation of proximal one third extraarticular tibia fracture is technically demanding surgery regardless of the implant.

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