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A comparative study of intramedullary nailing versus minimally invasive percutaneous plate osteosynthesis for extra-articular proximal tibia fracture: A prospective study

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Abstract

Aims: To compare the clinical and radiological outcome of extra-articular proximal tibial fractures treated with Intramedullary Nail And Minimally Invasive Percutaneous Plate Osteosynthesis with objectives -To assess the outcome in terms of fracture union by means of clinical and radiological features and outcome after surgical procedures, complications in these two methods of treatment

Methods: Our study consists of 40 cases of extra-articular proximal tibia fractures. All cases aged were more than 18 were operated at Sanjay Gandhi Institute of trauma and orthopaedics from December 2017 to June 2019. Clinical outcome was assessed through knee society score. All the cases in the study were post-traumatic. Mean duration of follow up was 6 months.

Results: Out of 40 patients, 36 were males and 4 were females. Average age of the patients was 38.40 years and 38.30 years in MIPPO group and IMN group respectively. 57.5% of the patients sustained a right sided fracture and 42.5% had left sided fracture. Mean knee society score of group 1 and group 2 at all visit of follow-up i.e 1 month, 2 month, 3 month, 6 month and 12 month were not significantly different from each other. Complication in both groups was also comparable.

Conclusion: Extra-articular Proximal tibial fractures can be effectively treated by interlocking intra medullary nails with multi directional locking options as well as with MIPPO with excellent results, There is no significant difference between two mode of treatment as far as early post-operative mobilization, intra operative blood loss, Hospital stay, knee society score and complication. The operative technique was simple and short. No significant difference were there in complications encountered in our study. It can be concluded that both the technique were equally effective and choice of methods depends on the surgeon own experience, setup and patient choice.

Keywords: Intra medullary interlocking system; MIPPO, Proximal tibial fracture

Introduction

The tibia is an important weight bearing bone in the lower limb, which articulates proximally with the femur at the knee and distally with the talus at the ankle. These meta-diaphyseal fractures are distinct in terms of their management from middle third diaphyseal injuries [1]. Treatment of proximal tibial fractures is challenging because of limited soft tissue cover and less vascularity. There are various treatment options for these fractures starting from closed reduction and casting to open reduction and internal fixation with plate. Open reduction and internal fixation with plate can result in extensive devitalization of soft tissue leading to wound healing problems [2] Fractures of tibia shaft are most common of long bone fractures. Proximal tibia fractures account for approximately 5% to 11% of all tibial injuries and affect knee function and stability in most of the case. Increased incidence of associated complications have made these fractures particularly problematic. The optimal method of surgical treatment for fractures of proximal third tibial shaft remains debatable [3]. As tibial fractures are commonly associated with soft tissue injury, if these are not properly treated these can cause substantial disability to the patient. High energy motor vehicle trauma constitutes the commonest cause followed by falls, direct blow, and sports injury [4]. The incidence of injuries and fractures has greatly increased in the present than the old days. Among all kinds of fractures, tibia fracture is the most common long bone fracture experienced by the orthopedic surgeons [5].

The fractures of proximal tibia are common intra-articular fractures. These injuries can be divided into two broad categories, high energy fractures and low energy fractures. Majority of these fractures are due to high speed velocity accidents or fall from height. where fractures results from direct axial compression, usually with a valgus (more common) or Varus moment and indirect shear forces. Elderly patients with osteoporotic bone are likely to sustain depressed type fracture [6]. Extra-articular proximal tibial fractures lead to complex tissue injuries of bone and surrounding soft tissues. Conservative management of these fractures has resulted in malunion, nonunion, rotational deformity, or stiffness of adjacent joints. So there has shift towards operative management of these fractures in recent times. However, surgically treating these fractures remains debatable [7]. In the recent world with the increase in the number of fast moving vehicles there is a great increase in number and severity of musculoskeletal trauma. The goal of fracture treatment is to obtain union of the fracture in the most compatible anatomical position which allows maximal and full restoration of the extremity [8]. Extra-articular proximal tibial fracture make up to around 10% of all shaft tibia fractures which are most commonly due to high velocity injury. Both conservative and operative management options are available for these fractures but conservative management have resulted in complications like non-union, malunion, stiffness of joints or rotational instability. So operative management is preferred over conservative management in these patients. Various options are available for operative management which include Im nailing, external fixation,

plating or a combination of these. In recent times, intramedullary nailing and minimal invasive plating are the preferred techniques of the available modalities of operative management. There is not enough evidence regarding the superiority of one of the two techniques [9].

Materials and Methods

This is a prospective study (Descriptive longitudinal study) of the Patients of Sanjay Gandhi Institute of Trauma And Orthopaedics, Bengaluru with Extra-articular proximal tibia fracture was admitted and operated Intra medullary nail or Minimally Invasive Percutaneous Plate Osteosynthesis. These patients were followed up at 1 month, 2 month and 3 month and 6 month and 12 months and assessed by clinically and radio graphically using the knee society score.

Operative technique

Nailing

For proximal fractures, the entry point was identified to be in line with the lateral tibial spine, thus slightly lateral than the standard nailing. In the sagittal plane, the entry point was as far proximal in the tibia as possible while the guide wire was inserted taking care to avoid posterior angulation, thus running along the anterior cortex possible while staying intramedullary. This served to prevent flexion deformity. Temporary blocking screws and reduction clamp were used to achieve reduction and removed after fracture fixation. The intramedullary nail used had a proximal Herzog band and four multilevel, multiplanar, and multidirectional screws (expert tibial nail).

Nail design

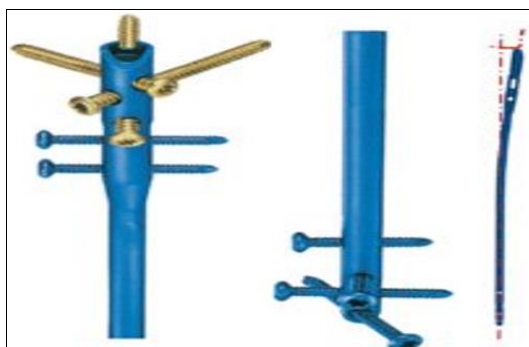


Fig 1: Intramedullary nail used in surgery

A Proximal Locking option b. Distal Locking option

Plating

A curvilinear incision over the lateral aspect of the proximal tibia was taken in the patients to be operated by plating. Axial

traction and reduction clamp was used to achieve reduction. 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.

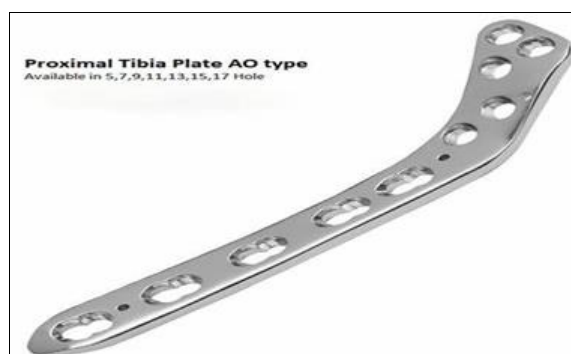


Fig 2: AO type proximal tibia plate used in surgery

Post-operative protocol

Post-operative protocol started after clinical and radiological assessment with Walking with support initiated simultaneously with partial /non weight bearing walking. Postoperatively static quadriceps exercise and ankle mobilization was started on the first postoperative day. Active and assisted knee mobilization was started on 2nd postoperative as tolerated by the patient. Full weight bearing only when signs of clinical and radiological union were present during follow up. Patients were followed up at regular intervals of 1, 2 and 3 months, and 6 month and 12 month.

Alignment and functions of the affected limb were assessed Alignment and deformity was calculated by drawing the anatomic axis of tibia in both proximal and distal fragments on radiographs. The amounts of varus/valgus and procurvatum/ recurvatum were then calculated. Varus and procurvatum angulation were expressed as positive values, and valgus and recurvatum as negative values. Union was defined as the ability to bear full weight without pain and support, with callus bridging in 3 of 4 cortices on radiographs.

Results

Table 1: Distribution of study subjects as per Age

Age groups	Group 1 (MIPPO)		Group 2 (Nail)		Total	
	No	%	No	%	No	%
≤ 20 yrs	1	5	1	5	2	5
21-30yrs	6	30	8	40	14	35
31-40 yrs	6	30	4	20	10	25
41-50 yrs	4	20	3	15	7	17.5
51-60 yrs	2	10	2	10	4	10
≥61 yrs	1	5	2	10	3	7.5
Total	20	100.0	20	100.0	40	100.0
Mean age	38.40		38.30		38.35	
SD, Range	13.69, 17-63 yr		16.38, 18-78 yr		14.90, 17- 78 yrs	

Mean age of both the groups are shown in Table-1. Difference of Mean age of both the groups are statistically insignificant P = 0.98, t- 0.02).

Table 2: Distribution of study subjects as per Laterality of fracture.

		Laterality		Total
		Left	Right	
Group 1	N	9	11	20
	%	45	55	100.0%
Group 2	N	8	12	20
	%	40	60	100.0%
Total	N	17	23	40
	%	42.5%	57.5%	100.0%

Pearson Chi-Square=0.10, P=0.75

Table 3: Distribution of study subjects as per Comorbidity

Comorbidity	Group 1 (MIPPO)		Group 2 (Nail)		Total	
	No	%	No	%	No	%
hypothyroidism	1	5	0	0	1	2.5
DM	3	15	3	15	6	15
Diabetic nephropathy	2	10	2	10	4	10
HTN	7	35	6	30	13	32.5
EPILEPSY	1	5	1	5	2	5
No comorbidity	6	30	8	40	14	35
Total	20	100.00	20	100.00	40	100.00

Table 4: Distribution of study subjects as per mode of injury

Mode of Injury	Group 1 (MIPPO)		Group 2 (Nail)		Total	
	No	%	No	%	No	%
Assault	2	10	1	5	3	7.5
Fall from Height	2	10	2	10	4	10
RTA	16	80	17	85	33	82.5
Total	20	100.00	20	100.00	40	100.00

Table 10: Functional outcome according to Knee society Score at 12 month

		Knee Society Score At 12 Month				Total
		Excellent 80-100	Good 70-79	Fair 60-69	Poor <60	
Group 1	N	19	1	0	0	20
	%	95	5	0	0	100%
Group 2	N	18	2	0	0	20
	%	90	10	0	0	100%

Pearson Chi square=10.619, p value=0.643

Table 5: Duration of Hospital Stay in two group of study subjects.

	N	Mean	Std. Deviation	P value	T value
Group 1	20	4.75	1.83	0.13	-1.52
Group 2	20	5.55	1.47		

Table 6: Duration of Surgery (Min) in the two group of study subjects

	N	Mean	Std. Deviation	P value	T value
Group 1	20	102.38	14.968	0.072	-1.84
Group 2	20	111.90	17.564		

Table 7: Intraoperative Blood loss (ml) in the two group of study subjects.

	N	Mean	Std. Deviation	P value	T value
Group 1	20	155.71	37.626	0.41	0.83
Group 2	20	144.29	48.639		

Table 8: Time to radiological union (week) in two grp of study subjects

	N	Mean (Weeks)	STD. Deviation	P Value	T value
Group 1	20	5.35	1.84	0.14	1.54
Group 2	20	4.65	0.87		

Table 9: ROM Knee in two GRP of study subjects

ROM Knee	Group 1 (MIPPO)		Group 2 (Nail)		Total	
	No	%	No	%	No	%
Full	16	80	17	85	33	82.5
Near Normal	4	20	3	15	7	7.5
Total	20	100.00	20	100.00	40	100.00

Table 11: Post-operative Complication in of study subjects

Complication	Group 1 (MIPPO)		Group 2 (Nail)		Total	
	No	%	No	%	No	%
Delayed Union	2	10	1	5	3	7.5
Infection	1	5	0	0	1	2.5
Malunion	3	15	2	10	5	12.5
Implant Failure	0	0	1	5	1	2.5
Superficial Infection	4	15	2	10	6	15
Wound Dehiscence	2	10	1	5	3	7.5
Tendon Exposed	0	0	2	10	2	5
No Complication	8	40	11	55	19	47.5
Total	20	100	20	100	40	100



Fig 3: (A) 35-year-old male patient suffering from tibial fracture due to traffic accident preoperative (a) anteroposterior and (b) lateral computed tomography scan showing fracture in the right proximal tibia (c) postoperative anteroposterior and (d) lateral X-rays after locked tibia intramedullary nailing via a suprapatellar approach with blocking screws (e) anteroposterior and (f) lateral x-rays showing union of fracture at 6Month followup (g and h) postoperative clinical photographs at 1 month showing flexion and extension of the knee

Discussion

In our study (Descriptive longitudinal study) was conducted in Sanjay Gandhi Institute of Trauma And Orthopaedics, Bengaluru during the period from november 2017 to june 2019 on 40 patients with extra-articular proximal tibia fractures and divided randomly into two groups whom operative line of management was considered in the form of either by Intra medullary nail or Minimally Invasive Percutaneous Plate Osteosynthesis and analysed. In our study average radiological union time for group 1 was 5.35 weeks and 4.65 weeks for group 2, union time of our study is lesser than study by Saied A *et al.* [50] it was found that The average time for union in the plating cohort was 4.30 ± 1.48 months, and in the intramedullary nailing cohort, it was 4.34 ± 1.45 months. The difference between cohorts was not significant ($P = 0.787$). There are many studies which shows union time similar to our studies. Jain S *et al.* [3] found Union time (Weeks) 16.2 and 18.1, Meena RC *et al.* [13] found Union time (weeks) or time required before full weight-bearing (weeks) 22.84 (16–34) and 18.26 (10–30), Pandey A *et al.* [7] noted 22.84 wk for 1st grp and 18.26 wk in 2nd grp, Gupta S *et al.* [10] found 16.7 and 14.2 wk, Patel Z *et al.* [9] noted 17 and 20 wk, Sharma AK *et al.* [11] found The Average time to union was 20 weeks (16 to 36 weeks) for plating group and 16.55 weeks (15 to 24 weeks) for nailing group. In 1989, The Knee Society Clinical Rating System was developed as a simple, but objective scoring system to rate the knee and patient's functional abilities such as walking and stair climbing. Since the scoring system did not include assessment of radiographs, The Knee Society endorsed a method to evaluate radiographs. The Knee Society Clinical Rating System has been the most popular method of tracking and reporting outcomes worldwide. However, the reliability, responsiveness, and validity of the original score have been challenged.

Mean knee society score at 1 month in group 1 and group 2 were 39.05 ± 10.19 and 38.25 ± 12.65 . Difference of both the groups is statistically not significant ($p=0.83$). at 2 month were 47.20 ± 10.64 and 45.65 ± 12.26 , difference is not significant ($p= 0.40$), 61.60 ± 11.45 and 60.10 ± 11.62 at 3 month and also not significant ($p= 0.68$), At 6 month mean knee society score of two groups were 78.95 ± 11.26 and 78.50 ± 11.33 which is also not significant. At 12 month mean knee society score were 88.85 ± 4.95 and 88.65 ± 6.05 , and not significant ($p=0.90$)

Complication

In our study in grp 1 i.e plating group 15% study subjects had malunion and superficial infection, 10% subjects had delayed union and wound dehiscence and 5 % subjects had infection, whereas in nailing group malunion, superficial infection and exposed tendon were present in 10% subjects each and delayed union, implant failure and wound dehiscence were in 5% study subjects each respectively. Plating has higher chances of skin infection and superficial necrosis which could be due to extensive dissection needed in plating and then type of fracture wherein plating is used being high velocity injury. Similar study done by Sharma AK *et al.* [11] concluded that, 2 patients in Plating group developed deep infection. They were treated with debridement and IV antibiotics and infection was controlled. One patient had late postoperative infection i.e., at the end of 12 months and was treated with implant removal. In nail group, one patient developed superficial infection which was managed with I.V. antibiotics for 3 weeks with alternate day dressings. In the study by Pandey A *et al.* [7] noted that In present study rate of mal union was higher in Group I treated with IMN as compared to the Group II treated with Plating 14.8% (1/7) cases develop malunion in followup. In study by Gupta S *et al.* [10] they found that Surgical site infections were seen in three patients in the group B, which resolved with debridement and antibiotics and no surgical intervention was required. No infection was reported in group A. Delayed union was seen in 3 cases of group A and was managed by dynamization. No patient developed non-union in group A. There was non-union in one patient in the group B; bone grafting was done in that case, which eventually led to fracture healing. In study by Patel Z *et al.* [9] concluded that The plating group also had 5 patients of malunion (16%), but the difference was not statistically significant. An important character of proximal tibia fractures is gross swelling around the fracture site. It is one of the character which was encountered in 90% of the proximal tibia fracture.

Conclusion

Extra- articular Proximal tibial fractures can be effectively treated by interlocking intra medullary nails with multi directional locking options as well as with MIPPO with excellent results, There is no significant difference between two mode of treatment as far as early post-operative mobilization, intra operative blood loss, Hospital stay, knee society score and complication. The operative technique was simple and short. No significant difference were there in complications encountered in our study.

It can be concluded that both the technique were equally effective and choice of methods depends on the surgeon own experience, setup and patient choice.

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