

# A study to assess the functional outcome of locking plate osteosynthesis for proximal tibia fractures

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## Abstract

**Background:** Knee joint is one of three major weight bearing joints in the lower extremity. The proximal tibial fractures are one of the commonest intraarticular fractures, generally these injuries falls into two broad categories, high energy fractures and low energy fractures. The aim of surgical treatment of proximal tibia fracture is to restore congruentarticular surfaces of the tibial condyles maintaining the mechanical axis and restoring ligamentous stability eventually can achieve functional painless and good range of motion in the knee joint. **Objective :** The objective to determine the functional outcome of the proximal tibia fracture treated with locking compression plate and to determine the duration of union in proximal tibia fractures treated with LCP. **Methodology:** A Prospective Observational study was conducted in K.V.G Medical College and Hospital Sullia Dakshina Kannada among the patients presenting with proximal tibia fracture for a period of 2 years from January 2017 to December 2018. All the patients who were admitted in the department of orthopedics at KVG Medical College with complaints of Fracture of Tibia at Proximal Site were included in the study. A total of 25 subjects with proximal tibia fracture was included in the study. All the subjects fulfilling the inclusion criteria during the study period were included in the study. **Results:** In the study 64% had surgery for <24 hrs, 24% for 24 to 72 hrs and 12% for >72 hrs. Mean duration of surgery was  $1.93 \pm 1.59$  days. 84% underwent ORIF and 16% underwent MIPO. The study of surgical approach in 68% was Anterolateral, in 16% was Anteromedial and in 16% combined approach was followed and in 68% bone graft was used. In the study none of the factors such as Mode of injury, Method of reduction and fixation, Laterality and Graft had significant influence on outcome among subjects with proximal tibial fractures. **Conclusion:** Open reduction is preferred and should be performed after a thorough study of the fracture geometry and planning of the reduction technique. Early mobilization produces faster rehabilitation. Post operative physiotherapy is also important. Supervised physiotherapy program is important to achieve better function.

**Key Words:** FRACTURES, TIBIAL, INJURY, OUTCOME, RANGE OF MOTIONS

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## INTRODUCTION

Knee joint is one of three major weight bearing joints in the lower extremity. The proximal tibial fractures are one

of the commonest intraarticular fractures, generally these injuries falls into two broad categories, high energy fractures and low energy fractures.<sup>1,2,3</sup> The aim of surgical treatment of proximal tibia fracture is to restore congruentarticular surfaces of the tibial condyles maintaining the mechanical axis and restoring ligamentous stability eventually can achieve functional painless and good range of motion in the knee joint.<sup>4</sup> 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, 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.<sup>5</sup> This lead to the development of the internal fixators. 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 leads to the development of the AO locking compression plate (LCP).<sup>6</sup> This new system has been regarded as technically mature. It offers numerous fixation possibilities and has proven to work well in complex fracture situations and in osteoporosis. Hence this study was conducted with the objective to determine the functional outcome of the proximal tibia fracture treated with locking compression plate and to determine the duration of union in proximal tibia fractures treated with LCP.

## MATERIAL AND METHODS

A Prospective Observational study was conducted in K.V.G Medical College and Hospital Sullia Dakshina Kannada among the patients presenting with proximal tibia fracture for a period of 2 years from January 2017 to December 2018.

All the patients who were admitted in the department of orthopedics at KVG Medical College with complaints of Fracture of Tibia at Proximal Site were included in the study.

### Inclusion criteria:

1. Patient with Schatzker type (2,3,4,5,6)
2. Patient of both sex included in study.
3. Patient of age >18 years were included in the study

### Exclusion criteria:

1. Patient < 18 years of age in whom growth plate is intact.
2. Patient with pathological fracture, open fracture and periprosthetic fracture

A total of 25 subjects with proximal tibia fracture was included in the study. All the subjects fulfilling the inclusion criteria during the study period were included in the study.

### Methodology:

Patient was hemodynamically stabilized and subjected to standard pre op protocol with routine blood investigations, X ray, CT scan wherever needed. Standard Operative protocols were followed for Proximal Tibia

Fractures. In the immediate postoperative period. Care was given to the general condition, fluid balance, IV antibiotic for 48 hours and analgesics. Whenever stable internal fixation was achieved, the patient was mobilized after 48 hrs after removal of the drains, post op x ray. Patient started with quadriceps strengthening exercises. From day 2 the range of motion allowed was 0-30. From the 5th day the range of motion was gradually allowed to be increased to 90 more after suture removal full range of movement was allowed. Patient was allowed to mobilize non weight bearing with help of walker and crutches for 4 weeks, then started with partial weight bearing mobilization till 8 to 10 weeks then started with full weight bearing mobilization. Follow up: The first follow up was usually between 4-6 weeks and later on patients were followed up at regular interval of 4-6 weeks till complete fracture union. During the follow up the course of fracture healing was documented radiologically with minimum 6 wks interval. The moment of complete healing was defined as radiologically complete bone regeneration at fracture site. Evaluation range of motion achieved, evaluation of any possible loss of reduction, assessment and analysis of any complication. Follow up of patients ranged from 30 weeks to 64 weeks.

**Statistical Methods:** Descriptive statistical analysis was carried out in the present study. Results on continuous measurements are presented on Mean  $\pm$  SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance was assessed at 5 % level of significance. Chi-square, Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups. 95% Confidence Interval has been computed to find the significant features. P value of < 0.05 considered as significant. Statistical software: The Statistical software namely SPSS 22.0, Stata 8.0, were used for the analysis of the data and Microsoft word and Excel version 2007 have been used to generate graphs, tables etc.<sup>7,8</sup>

## RESULTS

In the study 25 subjects with Proximal tibial fractures were included and analyzed. Mean age of subjects was  $42.53 \pm 11.23$  years, majority of subjects were in the age group 41 to 50 years (36%), 76% were males. 68% of fractures were on left side and 32% on right side. Most common mode of injury was RTA (88%) and fall (12%). Majority of the fractures were type II and type VI , 28% respectively (Table 1).

**Table 1:** General Profile distribution among subjects

		Count	(%)
Age	18-30	2	8.0%
	31-40	3	12.0%
	41-50	9	36.0%
	51-60	8	32.0%
	>60	3	12.0%
Sex	Male	19	76.0%
	Female	6	24.0%
Laterality of fracture	Right	8	32.0%
	Left	17	68.0%
Mode of Injury	RTA	22	88.0%
	Fall	3	12.0%
Schatzker's Classification	II. Cleavage with depression	7	28.0%
	III. Central depression	2	8.0%
	IV. Medial Condyle fracture	3	12.0%
	V. Bicondylar fracture	6	24.0%
	VI. Metaphyseal extension	7	28.0%

In the study 64% had surgery for <24 hrs, 24% for 24 to 72 hrs and 12% for >72 hrs. Mean duration of surgery was 1.93 ± 1.59days. 84% underwent ORIF and 16% underwent MIPO. The study of surgical approach in 68% was Anterolateral, in 16% was Anteromedial and in 16% combined approach was followed and in 68% bone graft was used (Table 2). Out of 17 patient in which bone graft were used, auto graft were used in 13 patient, and bone supplement was used in 4 patients.

**Table 2:** Surgery details distribution among subjects

	Duration to surgery	No of patient	Percentage (%)
Duration to surgery	< 24 hours	16	64.0%
	24-72 hours	6	24.0%
	>72 hours	3	12.0%
Method of reduction and Fixation	ORIF	21	84.0%
	MIPO	4	16.0%
Side of Surgical approach	Anterolateral	17	68.0%
	Anteromedial	4	16.0%
	Combined	4	16.0%
Bone graft	Yes	17	68.0%
	No	8	32.0%

In the study 76% had excellent results, 16% had good, 4% had Fair and Poor outcome respectively. 5 patients had complications in the study. Of them 40% had infection, 20% had Postoperative loss of reduction, Varus deformity and Knee joint stiffness respectively (Table 3). Associated injuries, such as distal radius fracture in contralateral limb was seen in 2 subjects, both patient were managed with open reduction internal fixation with locking compression plate, one patient had associated distal humerus fracture of ipsilateral limb, which was managed with ORIF with locking plate and one patient was having olecranon fracture in contralateral limb, which was managed with tension band wiring.

**Table 3:** Outcome distribution among subjects

	Clinical result	No. of cases	Percentage (%)
Clinical result (n =30)	Excellent	19	76.0%
	Good	04	16.0%
	Fair	01	4.0%
	Poor	01	4.0%
Complications (n =5)	Infection	2	40%
	Postoperative loss of reduction	1	20%
	Varus deformity	1	20%
	Knee joint stiffness	1	20%

Two patient developed infections at operative site, both patients were of Schatzekers type 6, associated with high velocity trauma, implant was removed in one patient after 1 year, other patient managed with antibiotics. Loss of reduction was seen in one patient, who was reported and satisfactory reduction was achieved. Varus deformity was seen in one patient due to collapse of medial condyle. Knee stiffness seen in one patient it was also associated with delayed

mobilization and infection. In the study range of bone union was 12 to 22 weeks, average time for union of fracture was  $16 \pm 2.51$  weeks. In the study none of the factors such as Mode of injury, Method of reduction and fixation, Laterality and Graft had significant influence on outcome among subjects with proximal tibial fractures (Table 4).

**Table 4:** Association between Outcome and various factors

		Fair and poor		Good and excellent		Total	Chi Square test, df, p value
		Count	%	Count	%		
Mode of injury	Fall	0	0%	3	13.0%	3	0.999#
	RTA	2	100%	20	87.0%	22	
Method of reduction and fixation	MIPO	1	50%	3	13.0%	4	0.600
	ORIF	1	50%	20	87.0%	21	
Laterality	Left	2	100%	15	65.2%	17	0.906
	Right	0	0%	8	34.8%	8	
Graft group	Graft	1	50%	16	69.6%	17	0.999#
	No	1	50%	7	30.4%	8	

# Fisher's Exact Test

## DISCUSSION

For many years, treating proximal tibial fractures has been the subject of much controversy regarding both the indications for surgical intervention and the specific type of intervention to be employed. These fractures often affect patients during the most productive years of their lives, with potentially devastating consequences. Especially in intra-articular fractures, inadequate treatment may result in joint instability and deformity coupled with a restricted range of motion.<sup>9</sup> Open reduction and rigid internal fixation, according to the principles of Association for Osteosynthesis/Association for the Study of Internal Fixation (AO/ASIF), has been the treatment of choice for decades. This treatment modality has yielded satisfactory short- and long-term results in much study. However, especially in the setting of high-energy, complex tibial-plateau fractures, conventional plating has been associated with a high rate of wound complications and deep sepsis.<sup>10</sup> In the present study out of 25 patient with proximal tibia fracture 8% of the patients were between 18-30 years, 48 % of the patients were aged 31-50 years and 44 % of the patients were above 50 years of age. The average age was  $42.53 \pm 11.23$  years. This age distribution shows involvement of young adults, who are highly prone to RTA. Porter<sup>10</sup> in 1970 reported an average age of 47 years in his study of 68 cases. Bowes and Hohl<sup>12</sup> in 1982 and Duvelius and Conolly<sup>13</sup> in 1988 reported average age group of 48 years, Vassilios *et al*<sup>9</sup> in 2011 showed average age 52.8. Our study had male (66.77 %) preponderance. Studies by Bowes and Hohl,<sup>12</sup> Vangsnes,<sup>14</sup> Duvelius and Conolly<sup>13</sup> showed a male preponderance. This result also shows Indian scenario, where male are more involved in outdoor work. Chaix *et al* in 1982 reported 71.6% of their cases were due to RTA, 16% due to fall from height, 12% due to fall from level surfaces and 1% due to sports injuries. Blokker *et al*<sup>15</sup> in 1984 reported the most common mechanism of injury were motor vehicle accidents 43.7%. In our study road traffic accidents (RTA) found as most

common cause of injury in 88% patients. In this study, 17(68%) patients sustained injury to the left and 8 patients to the right. Rasmussen D.S<sup>16</sup> reported the fractures were equally distributed in the right and left knee that is 131 on right and 129 on left. In our study 56.67% affected the lateral tibial condyle, isolated medial tibial condyle occurred in 13.3% where as involvement of bicondylar lesions were 30%. Rasmussen<sup>16</sup> reported 70% of the injuries affecting lateral condyle, 12% affecting medial condyle and bicondylar lesions in 18%. Lansinger O<sup>17</sup> reported 70% affecting the lateral condyle, 11% medial condyle and 19% bicondylar lesions. In our study the indications for the surgery were the same standard indications as for the tibial plateau fractures. 3mm depression was considered as an indication for surgery in our study. Similarly in Seppo E<sup>18</sup>, 3mm depression was considered, were as in studies by Burri *et al.*<sup>19</sup> 1mm depression and in Hohl *et al.*<sup>12</sup> 5 mm depression was considered. In our study Open reduction internal fixation was done in 21 patient (84 %) and MIPO technique for reduction and fixation in 4 patients (16%). In the study duration of procedure and soft tissue injuries are less in MIPO, compared to ORIF technique, wound healing was also better and faster in MIPO, compared to ORIF technique. But we need to carefully select patient for MIPO, based on fracture configuration. In our study of 25 patient primary bone grafting was done in 8 patients (32%). In the study by Vassilios in 2010 primary bone graft was used in 45 %. In this study out of 25 patients we preferred early fixation of fracture in 16 patients (84%) and underwent surgery within 24 hours, 16 patient underwent surgery between 24 -48 hours and 3 patient (10 %) underwent surgery after 72 hours because of soft tissue swelling. In our study 1 patient with Anterolateral and posteromedial plate complained of pain and tingling, on investigation one screw of posteromedial plate found to be close contact with peroneal nerve, patient relieved after removing posteromedial plate. In our study bone union found in range of 12 to 22 weeks, average time for

union of fracture 16 weeks. It was comparable to study by Vassilios *et al.*,<sup>9</sup> which showed average union time at 3.2 month. In the study the period of immobilization was individualized depending on the security of stable fixation. The benefits of early knee motion include reduce of knee stiffness and improved cartilage healing (regeneration) and promote good callus formation and remodeling. In spite of complications, our study was able to achieve excellent results in 76 % and good results in 16% (over all 92 %, acceptable results) with standard surgical care. Poor result was seen in 4% because of infection. These results are comparable and on par with other documented studies. Similar outcome was seen in the study by Lachiewicz<sup>20</sup> *et al*, i.e. 93% had satisfactory outcome, were as in the studies by Joseph Schatzker<sup>21</sup> *et al.*, and Stokel<sup>22</sup> *et al.*, 78% had Satisfactory outcome and 65% had Satisfactory outcome respectively.

## CONCLUSIONS

From the study it can be concluded that the locking compression plate system with its various type of fixation act as a good biological fixation including difficult fracture situations. Fractures treated with MIPO healed rapidly by secondary fracture union and hence achieving strong bone union across the fracture at a much earlier time compared to open reduction and internal fixation due to less soft tissue injury leads to minimal blood supply interruption to proximal tibia.

## RECOMMENDATIONS

From the study it is recommended that locking compression plate system with its various type of fixation provides excellent outcome in proximal tibial fractures. The study also recommends for the following guidelines to achieve excellent results in proximal tibial fractures

1. Open reduction is preferred and should be performed after a thorough study of the fracture geometry and planning of the reduction technique.
2. Early mobilization produces faster rehabilitation.
3. Post operative physiotherapy is also important. Supervised physiotherapy program is important to achieve better function.

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