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A prospective study of surgical management of proximal tibia and distal tibia fracture treated with locking compression plate

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Abstract
Background: This new system has been regarded as technically mature. It offers numerous fixation possibilities and has proven its worth in complex fracture situations and in revision operations after the failure of other implants.
Methods: The present study includes a total of 25 cases of which 20 are of proximal tibia and 5 of distal tibia fracture treated using Locking compression plate & evaluated using Rasmussen S Functional Grading System.
Results: The present study consited total of 25 cases of which 20 are of proximal tibia and 5 of distal tibia fracture. 15 of them were treated by MIPPO technique and 10 by open reduction and internal fixation using Locking compression plate. The study period was from June 2014 to June 2016.
Conclusion: Proper understanding of the biomechanics of the LCP and the general principles guiding its application is essential before actually venturing into its clinical use. The change in the thinking is needed to accept the principles of biologic fixation

Keywords: Proximal & distal tibia, locking compression plate, MIPPO

Introduction
Proximal tibial fractures are one of the commonest intra-articular fractures. It results from indirect coronal or direct axial compressive forces. These fractures encompass many and varied fracture configurations that involve medial, lateral or both plateau with many degrees of articular depressions and displacements. Each type has its own characteristic morphology and response to the treatmet. It is essential to determine the forces of injury since high-energy trauma is associated with considerable soft tissue and neurovascular damage. Apart from tibial plateau bony injury, meniscal tear and ligament injuries should be assessed [1].
There are different modalities of managing distal tibial fractures, but there is no single method which solves all the problems associated with these fractures. The reason being relative a vascularity of distal tibia which delays the fracture healing. It is difficult to obtain satisfactory reduction and fixation due to the short distal fragment resulting in instability at the fracture site.
Advance in mechanization and the acceleration of travel have been associated with increase in the number and severity of fractures. Fractures of proximal and distal tibia are no exception to it. In the recent years road traffic accidents are emerging as one of the leading causes of death in the people with age group of 15-45 years. Similarly falls are major causes of morbidity and mortality in people above the age of 60years.
In both these groups the patients present with severe or complex injuries. The younger generation usually sustain high velocity trauma leading to complex fractures and the elderly people present with an equally severe problem of osteoporosis which make the fractures complex. To handle these groups, there has been a constant research with newer modalities of fixation and the birth of the concept of biological fixation.
Intramedullary nails are one of the earliest implants to achieve this concept of biological fixation. But intramedullary devices are not the choice in some fractures, especially those around the joints or those with metaphyseal extensions very close to the joints. As in fractures of proximal and distal tibia though specially designed nails like Expert Tibial Nails are available still use of these intamedullary nails for these poses difficulty in fracture reduction

And has got a steep learning curve. Use of intramedullary nails in these fractures results in valgus/varus malunion / anterior / posterior angulation at the fracture site, implant failure, delayed union and non union.

Originated Minimally invasive plate osteosynthesis (MIPO) 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 poses the same problem of poor fixation with convention plates.

This lead to the development of the internal fixators. PC-fix I was the first to be developed, followed closely by PC-fix II. As more and more concepts about biological fixation became clearer the development of internal fixators progressed, leading to development of Less Invasive Stabalising System (LISS), first for distal femur and then for proximal tibia.

Since still a gap existed between the two principles of conventional plating and the biological plating, there was a need to bridge this gap.

Research to combine these two methods or the possibility to combine these two methods has lead to the development of the AO Locking Compression plate (LCP).

This new system has been regarded as technically mature. It offers numerous fixation possibilities and has proven its worth in complex fracture situations and in revision operations after the failure of other implants[2].

Methodology

The present study includes a total of 25 cases of which 20 are of proximal tibia and 5 of distal tibia fracture treated using Locking compression plate between June 2014 to June 2016 at Sapthagiri Institute Of Medical Sciences And Research Center, Bangalore.

Inclusion Criteria

- Age : Above 15 years
- Patients with closed, open type I, type II fractures of proximal and distal tibia

Exclusion Criteria

- Age: Below 15 years
- Open Type III fractures
- Medically not fit for surgery.

On admission of the patients, demographic data was recorded and a careful history was taken from the patients or attendants to reveal the mechanism of injury and severity of trauma. The patients were then assessed clinically to evaluate their general condition and the local injury.

Methodical examination was done to rule out other fractures. Local examination of the injured leg revealed swelling, tenderness, crepitus, deformity and loss of function. Neurovasucular injuries were looked for and noted if any.

Further investigations were done depending on the general condition of the patient and the routine pre-operative protocol as per our hospital guidelines. Radiographs of the leg i.e. anterior posterior and lateral view were obtained. The limb was then immobilized in above plaster of Paris slab and limb kept in an elevated position.

The patients were taken for the surgery after routine investigation and after obtaining the fitness for surgery. the investigations are as follows ; routine hemogram, blood urea, serum creatinine, FBS, HIV, HbsAg, chest x –ray and ECG

Depending on the type of fracture, amount of comminution, the associated soft tissue injury etc, the technique of reduction and principle of fixation was decided. We treated 12 patients with proximal tibia fracture and 3 patients with distal tibia fractures by Minimally invasive Percutaneous osteosynthesis; 8 patients of proximal tibia fracture and 2 patient with distal tibia fracture by open reduction and internal fixation.

Results

Table 1: Age Distribution

Age group	Proximal		Distal	
	No of patients	%	No of patients	%
21-30	7	35	1	20
31-40	6	30	1	20
41-50	5	25	2	40
51-60	2	10	0	0
>60	0	0	1	20
Total	20	100	5	100

The age group of the patients in our study of proximal tibial fractures ranged from 21yrs to 60yr s (mean 37.1 yrs).

The age group of the patients in our study of distal tibial fractures ranged from 21yrs to 65yr s (mean 45.8 yrs).

Table 2: Sex Distribution

Sex	Proximal		Distal	
	No of patients	%	No of patients	%
Male	19	95	3	60
Female	1	05	2	40
Total	20	100	5	100

Most of our patients were males. It reflected the general population which visits our both outpatient as well as the emergency trauma section. This incidence of sex ratio can be attributed to an overwhelming large population of male patients, because in our Indian setup, the female population largely working indoor or in the agricultural fields and do not indulge themselves in travelling or outdoor activities.

Table 3: Mode of Injury

Mode of injury	Proximal		Distal	
	No of patients	%	No of patients	%
Rta	19	95	3	60
Fall	1	05	2	40
Total	20	100	3	60

Most of the cases in our study were due road traffic accidents. Rest being due to fall.

Table 4: Fractured Bone

Bone	No. of patients	Percentage
Proximal tibia	20	80
Distal tibia	5	20
Total	25	100

In our series we had 20 cases with fracture of proximal tibia and 5 cases with fracture of distal tibia, all of them were not amenable to treatment by standard intramedullary nailing. Most of them were comminuted fractures

Table 5: Method of Reduction And Fixation

Method of reduction	Proximal		Distal	
	No of patients	%	No of patients	%
ORIF	8	40	2	40
Closed, MIPO	12	60	3	60
Total	20	100	5	100

We used MIPO technique for 12 patients with proximal tibia fractures and ORIF in 8 patients with proximal tibia fractures. We found as the study progressed that the operative time needed for MIPO decreased as we matured more in this technique.

We used MIPO technique for 3 patients with distal tibia fracture and ORIF in 2 patients with distal tibia fractures.

Table 6: Duration of Fracture Union

Duration (weeks)	Proximal		Distal	
	No of patients	%	No of patients	%
12-15	15	75	1	20
16-18	2	10	2	40
19-24	2	10	1	20
>24	0	0	1	20
Nonunion	1	05	0	0
Total	20	100	5	100

Most of the proximal tibia fractures united by 12-15 weeks ranging from 12-20 weeks with an average union time of 13.75 weeks.

Most of the distal tibia fractures united by 16-18 weeks ranging from 15-28 weeks with an average union time of 19.4 weeks.

Table 7: Complications

Complication	Proximal No of patients	Distal No of patients
Loss of reduction	1	0
Infection and wound dehiscences	2	0
Malunion	2	0
Delayed union	0	1
Non union	1	0
Total	6	1

We had no case of any purely implant related complications like screw loosening, screw breakage, plate failure.

Discussion

Proximal and distal tibial fractures are one of the commonest intra articular fractures and are major injuries occurring as a result of road traffic accidents. It is sometimes associated with other bony and soft tissue injuries. Any fracture around the joint especially weight bearing knee joint in the lower limb is of paramount importance as would result in significant morbidity and quality of life. Hence treatment of these fractures has become a challenge for the orthopaedic surgeons.Keeping our aims of the study at high, we presented this clinical study of 25 cases of

proximal and distal tibia fractures treated using Locking compression plate. We evaluated the results and compared with those obtained by various other studies. Our analyses are as follows.

In our study fracture of proximal tibia was common between the age group of 21-30 years with an average of 37.10 years (21-55 years)

Our findings are comparable to the studies made by Seppo [3] *et al.*, Mathur hitin [4] *et al.*, John Keun [5] *et al.*, Lindvall edvic [6] *et al.*, Boldin [7] *et al*. The table below shows the average age in various series

Series	Min age (yrs)	Max age (yrs)	Average (yrs)
Seppo [3]	20	60	39.8
Mathur hitin [4] *et al.*	18	65	42.7
John keun [5] *et al.*	27	74	48
Lindvall edvic [6] *et al.*	18	71	39.6
Boldin [7] *et al.*	28	80	62
Present study	21	55	37.10

In our study of fracture of distal tibia average age was 45.8 years (30-65 years). The results were comparable with studies conducted by Hasenboehler [8] *et al.*, Hazarika S [9] *et al.*, Redfen DJ [10] *et al.*

Series	Min age (yrs)	Max age (yrs)	Average (yrs)
Hasenboehler E [8] *et al.*	16	72	45
Hazarika S [9] *et al.*	19	69	44.7
Redfen DJ [10] *et al.*	17	71	38.3
Present study	30	65	45.4

Our series of proximal tibia fractures had male predominant with 95% of male patients and 5% female patients which can be attributed to our Indian setup where the female population largely work indoor which were comparable to previous studies.

Mathur hitin *et al.* showed 82.60% of males and 17.40% of females

John keun and others showed 73.68% of males and 26.32% of females

Lindvall edvic, Sanders Roy *et al.* showed 73.72% males and 26.28% females.

In our study of distal tibia fractures 60% were males and 40% were females.

In Hasenboehler *et al.* series they had 81.25% males and 18.75% females. In case of Hazarika *et al.* series they had 80% males and 20% females. In the study conducted by Redfen DJ *et al.* they had 81.81% males and 18.19 females.

The functional results were assessed using Rasmussen S functional frading system. Accoding to this results are graded as Excellent-27 points, Good-20 points, Fair-10 points, Poor- 6 points.

In proximal tibial fractures we had 14(70%) excellent results, 2(10%) good, 2(10%) fair and 2(10%) poor.

Conclusion

Fixation of proximal and distal tibia fractures with locking compression plate is an excellent mode of fixations as it gives good results and minimizes the complication rate.

Locking compression plating of the proximal and distal tibia fractures produces excellent results when applied properly. To obtain good results proper preoperative planning, minimal soft tissues dissection, strict asepsis, post-operative rehabilitation and patient education is important

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