STUDY OF COMPLICATIONS AND FUNCTIONAL OUTCOME OF FIXATION OF DISTAL TIBIAL FRACTURES WITH ANATOMICAL LOCKING PLATE USING MIPO TECHNIQUE

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ABSTRACT

BACKGROUND

Managing the distal tibia fractures is still a challenge to orthopaedic surgeons even today in terms of soft tissue healing, accurate fracture reduction and fixation.¹ Minimal invasive plate osteosynthesis (MIPO) with anatomical contoured plate is an established technique for fixation of fracture of the distal tibia.^{2,3} Locking plate have the biochemical properties of internal and external fixation with superior holding power.⁴ Because of fixed angular stability through the head of locking screws, independent of fixation fit and if treated by minimal invasive osteosynthesis has the advantage of biological fixation.^{5,6}

The aim is to evaluate the results of minimally invasive plate osteosynthesis using anatomical contoured locking plate in management of distal tibial fractures in terms of radiological fracture union, restoration of ankle function and complications.

MATERIALS AND METHODS

This is a prospective study of 24 patients with distal tibial fractures treated with minimally invasive antero-medial locking plate. This study evaluates the bone and soft tissue healing along with complications related to soft tissue and bone from Sept. 2013 to Sept. 2014 in Gandhi General Hospital/Gandhi Medical College; 24 patients of distal tibial fractures were operated by MIPO technique with distal tibial anatomical locking plate on anteromedial aspect of tibia and all cases are followed up both pre- and post-operative for a period of 12 months.

RESULTS

The mean fracture healing time was 20 weeks (Range 14 - 24 weeks). At last followup superficial skin infection with skin dehiscence occurred in 4 patients (16.5%), delayed union in 2 patients (8.5%) and ankle stiffness in 2 patients (8.5%).

CONCLUSION

The minimally invasive fixation of distal tibial fractures with anteromedial locking plate is a safe method of fracture stabilisation. This technique should be used in all distal tibial fractures, particularly where interlocking nail cannot be done in distal tibial fracture with small distal metaphyseal fragments, vertical splits and fracture with intra-articular extension.

KEYWORDS

Distal Tibial Fractures, Anatomical Locking Plate, MIPO Technique.

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BACKGROUND

Fractures of distal tibia are critical because the tibial bone in lower end is subcutaneous with minimal muscle cover and with precarious blood supply, which makes fracture in this part of tibia prone for many complications like wound dehiscence, infections, delayed union, malunion and ankle stiffness following surgery or conservative management.^{1,7} The ideal treatment for unstable distal tibial fractures remains controversial. Conservative management with pop cast application and immobilisation leads to ankle stiffness (Upto 30% of cases) as well as shortening and angulation at fracture site in significant number of cases.⁸ Open Reduction and Internal Fixation (ORIF) with conventional plate is associated with high risk of infection, delayed union and non-union because ORIF needs extensive soft tissue dissection.²

Nail osteosynthesis is the preferred treatment in middle 3rd region shaft fractures, but is not always possible for distal third fractures with small metaphyseal fragment, spiral fractures and comminuted fractures.⁹

Minimally Invasive Plate Osteosynthesis (MIPO) using anatomically contoured locking plate reduces iatrogenic soft tissue injury and preserves bone vascularity,² and aims to achieve correct limb length and both axial and rotational alignment of the bone fragments^{5,4,6} with minimal damage at bone fracture site, while preserving fracture haematoma.¹⁰ Results of closed reduction and percutaneous plating for distal tibial fractures are encouraging. We studied prospectively 24 number of cases who underwent MIPO for distal tibial fractures and evaluated them for functional and radiological outcome in these cases.

MATERIALS AND METHODS

We prospectively analysed patients with distal tibial fractures came to Gandhi Medical Hospital/Gandhi Medical College between Sept. 2013 to Sept. 2014. During this period, a total number of 24 patients were operated as aged between 25 - 80 years with mean age of 39 years. There were 20 males and 4 female patients. All fractures are classified according to Ruedi-Allgower classification⁸ and Gustilo-Anderson classification. All closed fractures and Gustilo-Anderson type I and type II

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compound fractures of distal tibia with or without intra-articular extension upto 10 days old fracture are included in the study. Pathological fractures, compound fractures, Gustilo-Anderson type III and fractures more than 2 weeks old are excluded from this study. In all the patients at the time of admission, a careful history was taken to identify the mechanism of injury, severity of trauma. All the patients were submitted to routine AP and lateral view x-ray of leg and ankle were taken. All the patients were evaluated to these general conditions and below knee pop slab were applied till the surgery was taken up. Surgical profile, consent for surgery and appropriate prophylactic antibiotics were given before surgery.

Parameter		Degree	Score
1.	Pain	None	25
		While Walking on Uneven Surface	20
		While Walking on Even Surface Outdoors	10
		While Walking Indoors Constant and Severe	5
2.	Stiffness	None	10
		Stiffness	0
3.	Swelling	None	10
		Only in Evenings	5
		Constant	0
4.	Stair-Climbing	No Problems	10
		Impaired	5
		Impossible	0
5.	Running	Possible	5
		Impossible	0
6.	Jumping	Possible	5
		Impossible	0
7.	Squatting	No problems	5
		Impossible	0
8.	Supports	None	10
		Taping, Wrapping	5
		Stick or Crutch	0
9.	Work, Activities of Daily Life	Same as Before Injury	20
		Loss of Tempo	15
		Change to Simpler Job	15
		Severely Impaired Work Capacity	0
Table 1. Oleaur and Mollander Scoring System was used in this Study to Assess			

Age (In years)	No. of Patients	Percentage
21 - 30	4	17
31 - 40	8	33
41 - 50	4	17
51 - 60	4	17
61 - 70	2	8
71 - 80	2	8
Total	24	100
Sex		
Male	20	83
Female	4	17
Total	24	100
Table 2. Showing Age Distribution		

	No. of Patients	Percentage
Side of Injury		
Right	16	67
Left	8	33
Mode of Injury		
RTA (High energy)	20	83
Fall (Low energy)	4	17
Type		
Closed	18	75
Open	6	25
Table 3. Side and Mode of Injury		

	No. of Patients	Percentage
Type of Open Fracture		
Type I	4	75
Type II	2	25
Type III A	-	-
Type III B	-	-
Type III C	-	-
Fracture Pattern		
A1	6	25
A2	2	8
A3	12	51
B1	-	0
B2	-	0
B3	-	0
C1	2	8
C2	2	8
C3	-	0
Table 4. Showing Duration of Surgery and Fracture Union		

Surgical Techniques

Patients were operated under regional anaesthesia under tourniquet control. Patients were placed on C-arm compatible table in supine position, a vertical incision about 3 cms was placed over medial malleolus. The anatomical pre-shaped 4.5 mm locking plate (Sharma surgical) was inserted extra periosteally under C-arm control. Closed reduction of fracture was obtained by manual traction/calcaneal pin/Schanz pin in distal tibia. Then the plate was implanted with at least 3 locking screws in proximal tibia and distal fragment (5.0 mm and 4.5 mm screws respectively) when there was comminution of fracture; fibula was also fixed with 3.5 mm reconstruction plate or semi-tubular plate depends on the need for accurate limb length and to maintain stability at fracture site in tibia.

Post-operatively, an above knee pop slab was applied for one week to get the limb oedema to be reduced. Sutures were removed at the end of 2 weeks; early active and passive knee and ankle movements were encouraged on next day of surgery. Touch down weight bearing with help of walker and partial weight bearing started the movement with callus seen on x-ray. Patients were regularly followed up at 3 weeks, 6 weeks and months 3, 6, 9 and 12. Bone union was defined as presence of callus bridging on radiograph and the ability to full weight bearing without pain.

	No. of Cases	Percentage
Duration of Surgery (In minutes)		
51 - 60	16	68
61 - 70	2	8
71 - 80	2	8
81 - 90	4	16
Duration of Fracture Union (In weeks)		
14	12	48
16	8	36
18	2	8
20	2	8

Table 5. Duration of Surgery and Fracture Union

RESULTS

The age of the patients ranged from 25 - 80 years with mean age of 39 years; there were 20 male and 4 female patients. The mode of injury in majority of patients was road traffic accidents. The majority of the fractures included in our series were extra-articular and associated with fibula fracture at about the same level.

The mean duration between trauma and surgery was 7 days with a range of 5 - 12 days. The average surgery time was 90 minutes with average time of 70 - 140 minutes. The mean fracture healing time was 20 weeks (14 - 24 weeks), mean hospital stay was 16 days (8 - 20 days). Partial weight bearing with crutches started at 10 days and the mean time of callus formation was 10 weeks. The mean time for full weight bearing was 15 weeks (Between 8 - 22 weeks). On average 60% of patients had Oleaur and Mollander et al score of 80 points out of 100 points with average of 90 points. We encountered superficial skin infection and dehiscence in about

4 patients (16.6%) who responded well to regular dressing and extended dose of oral antibiotics for few more days. All the patients sustained direct injury to leg leading to associated soft tissue damage at site of fracture.

Two patients were treated for delayed union as a result of high comminution at the site of fracture in one case and grade 2 compound fracture in other case; both these cases united at the end of 24 weeks. Two patients (8.5%) developed ankle stiffness with ROM of 50% of contralateral side due to lack of regular followup, who were advised active movements at guidance of physiotherapist. No patient in our series had plate bending, vascular injury or tourniquet palsy.

Score	Results
100 - 80	Excellent
50 - 79	Good
25 - 49	Fair
< 25	Poor

Table 6. Rating According to Oleaur and Mollander Scoring System

Complications	No. of Patients	Percentage
Superficial Skin Infection	2	16
Ankle Movement Restriction		
> 75%	0	0
50 - 75%	0	0
25 - 50%	0	0
< 25%	2	16
Anterior angulation 5°	0	0

Table 7. Showing Complications

Rating	Ankle/Subtalar Motion	Tibiotalar Alignment	Tibial Shortening	Chronic Swelling	Pronation/Supination	Equinus Deformity
Excellent	> 75% Normal	Normal	None	None	Normal	None
Good	50 - 75%	Normal	None	Minimal	Normal	None
Fair	25 - 50%	< 5U Angulation	< 1 cm	Moderate	Moderate Decrease	None
Poor	< 25%	> 5U Angulation	> 1 cm	Severe	Marked Decrease	Present

Table 8. Showing Objective Criteria (American Ankle & Foot Score)

DISCUSSION

The distal tibial fractures remain a challenge to orthopaedic surgeons even today, because of dilemma of method of fracture fixation either open plate/locked ILN or conservative management with pop casing.^{1,7} Minimally invasive percutaneous osteosynthesis with anatomical pre-contoured distal tibial plate was now an established technique of management of distal tibial fractures.^{11,12} Conservative management with pop immobilisation was associated with prolonged period of rest and ankle stiffness. Open reduction and DCP plate fixation and locked IM nails were associated with more number of infections, delayed union, non-union of fracture and soft tissue healing problems from dissection of soft tissue while doing surgery.^{10,9} Damage to distal tibial extraosseous blood supply provided by branches at anterior and posterior tibial arteries was least with MIPO technique. Hence, chances of complications are less and rate of bone union was high.¹² We evaluated our results and compared with those obtained by various other studies utilising different modalities of treatment and MIPO technique for distal tibial

fractures as our analysis follows. Our study revealed the average age of patients was 39 years (25 - 80 years), was comparable with study on similar fractures conducted by other authors. In our study more number of male patients are involved over females, i.e. 85% compared to the study conducted by Collinge C et al,¹¹ which was 77% possible due to the fact that males travel a lot and these are occupational injuries. Our study had 25% compound fractures, was compatible to studies conducted by Heather and Vallier⁹ et al who had 30% open fractures. The average operation time was 60 minutes (55 - 85 minutes) comparable with the average of 77 minutes by J. J. Guo et al in their study. The average time taken for fracture to unite was 24 weeks comparable to 16 - 28 weeks in various studies^{11,12} conducted using MIPO technique, which was comparable to our study.

CONCLUSION

The MIPO technique for fracture of distal tibial fracture was an established procedure with less incidence of delayed union, non-union, skin complications and infections because of less

disturbance to bone vascularity and soft tissue damage around fracture site during surgery. MIPO technique can be used even in distal tibial fractures with small distal fragment, comminuted fractures and fracture with intra-articular extension.

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