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Surgical management of distal tibia fracture by mippo using locking compression plate

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Abstract
Introduction: The following study was conducted to examine the short term clinical and radiological results particularly early complications and healing rate of distal tibia fracture treated by MIPPO using LCP.
Methodology: The study was conducted in patients treated for distal tibia fracture (type A, B & C – AO classification) at Adichunchanagiri Institute of Medical Science, BG Nagar from the month of Nov 2013 to Nov 2015. Twenty distal tibia fracture patients were taken into the study, all were fixed with LCP by mippo, some with Bone grafting where the distal tibia fractures were associated with bone loss and communition. Patients' age ranged from 27 to 68 years with a mean of 50.
Results: The sample consisted of twenty patients with 11 males and 09 were female. The patients' ages ranged from 27-68 years with a mean age of 50 years. The causes of fractures were motorvehicle accident in 13 patients and fall in 07 patients. There were no sports or industrial accidents. 12 fractures involved the right side and 08 involved the left. The average length of hospitalisation was 15 days with a range of 10 to 20 days. The average number of days from injury to surgery was 5 days with a range of 2 to 10 days. The operative time ranged from 45 minutes to 120 minutes. Patients were followed up from 01 to 24 months. Functional outcome was rated as per The modified ankle score of Olerud and Molander, we got excellent results in 10 cases, good in 07, fair in 02 and poor in one patient.
Conclusion: The LCP is a good implant to use for fractures of the distal tibia by mippo method. However, accurate positioning and fixation are required to produce satisfactory results. We recommend use of this implant in Type A, B and C, osteoporotic fractures. Our early results were encouraging but long term studies are needed to prove definitively acceptable outcomes so that the technique can become part of the armamentarium of the orthopaedic trauma surgeon.

Keywords: Distal tibia fracture, MIPPO, Distal tibia LCP, Pilon fracture

1. Introduction
Increased incidence of road traffic accidents, natural disasters, industrial accidents claim most of human mortality and morbidity. Of these fractures distal tibia have historically been difficult to treat.
Distal tibial fractures often presents a challenge to orthopaedic surgeon. Destot first used the term in 1911, likening the pilon to a pestle. The tibial pilon comprises anatomically the distal end of the tibia including the articular surface. Its proximal limit is found approximately 8-10cm from the ankle articular surface, where the triangular section of the tibial diaphysis, with its anterior crest, changes direction forming the metaphysis. The three-dimensional configuration of this region appears to be designed to increase the area of the articular surface, reducing the stress on the ankle joint.
Tibial pilon fracture represents 5-7% of all the tibial fractures [1]. These are usually the result of high energy axial compression and rotation forces. They are usually associated with severe soft tissue compromise. The limited soft tissue coverage, subcutaneous location, poor bone quality, osteoporosis renders the tibial fracture very challenging. The treatment of unstable distal tibia or pilon fracture remains controversial. To achieve union many procedures are recommended such as closed reduction and cast, open reduction and internal fixation, intramedullary nailing, hybrid or ring external fixation.

The difficulties that arises in the treatment of fracture distal tibia are

1. Tendency to re-displacement of fracture fragment following subsidence of swelling specially in oblique, spiral and comminuted fractures when treated by cast
2. Delayed union due to the precarious vascularity in distal tibia
3. Functional and cosmetic deformation if rotational or alignment position of the fragment is not achieved, as it is important because knee and ankle joints are in same parallel axis
4. Bone loss

Non surgical treatment option is possible for fracture with minimal shortening, but requires prolonged immobilisation. It has also been associated with malunion, deformity, shortening of affected limb, limitation of range of motion and early osteoarthritis. Also prolonged recumbency resulted in high incidence of thromboembolic disease and pneumonia.

Non-surgical approach with calcaneal traction remained the treatment of choice prior to case series reported by Reudi and Allgower in 1969 with 84 fractures treated with standard open protocol with 74% of patients reported good to excellent function.

External fixation can be a useful option in open fractures with soft tissue injury, but can lead to pin-track infections, septic arthritis, mal-alignment and delayed union. Soft-tissue management has been seen to play a vital role in the management alongside the bony reconstruction.

Conventional plating techniques if applied to multifragmentary fractures, requires anatomic reduction, wide surgical exposure and the fractured fragments are stripped off the soft tissue attachments resulting in a variety of complications like delayed union or non-union, infections, implant failure skin necrosis and wound dehiscence.

Biological plate fixation technique are based upon the principles of limited soft tissue stripping, maintenance of osteogenic fracture hematoma and preservation of vascular supply to the individual fracture fragment while restoring axial and rotational alighnment and providing sufficient stability to allow progression of motion, uncomplicated fracture healing and eventual return to function. As such, the evolution of biological plating technique has led to development of low profile, precontoured implants specifically intended for application in the distal tibia

2. Materials and methods

The study was conducted in patients treated for distal tibia fracture (type A, B & C – AO classification) at Adichunchanagiri Institute of Medical Science, BG Nagar from the month of Nov 2013 to June 2016. twenty distal tibia fracture patients were taken into the study, all were fixed with LCP by MIPPO Patients' age ranged from 27 to 68 years with a mean of 50 with the duration of follow up ranged from 6 months to 24 months Surgical Technique: Patient in supine position. Initial fibula fixation was routinely done with one third tubular plate. It restores limb length and helps in the reduction of the tibial plafond in the correct position [50] A vertical or curvilinear incision was made at the level of medial malleolus with the utmost care not to injure great sephanous vein and sephanous nerve. Sub cutaneous plane was made with hemostat without striping periosteum and disturbance to fracture haematoma. Fracture was reduced under C arm control. where reduction was difficult, we made a small incision and used a Kirschner wire (3mm) as a joystick to aid in fracture reduction and towel clip or reduction clamp to hold reduction. Varus -valgus angulation < 5° and anterior-posterior angulation < 10° and shortening of < 15 mm were considered acceptable criteria for reduction. Precontoured low metaphyseal LCP was tunneled into subcutaneous plane and its position was reconfirmed with C arm. Before fixing the plates with screws, shagging of distal fragment was prevented by putting towel roll under the fracture site. Provisional nonlocking screw was applied to bring the plate on the bone. If necessary, interfragmentary compression was achieved by a screw through the plate or outside the plate. Compression osteosynthesis was achieved in simple fracture by using nonlocking screw on proximal to fracture site as a hybrid fixation [51, 52]. With separate stab incision, at least three locking screws were applied on the either side of fracture under c arm guidance Primary bone graft was done whenever necessary to promote union. Skin was closed with nonabsorbable sutures

3. Results

The sample consisted of twenty patients with 11 males and 09 were female. The patients' ages ranged from 27-68 years with a mean age of 50 years. The causes of fractures were motorvehicle accident in 13 patients and fall in 07 patients. There were no sports or industrial accidents. 12 fractures involved the right side and 08 involved the left. The average length of hospitalisation was 15 days with a range of 10 to 20 days. The average number of days from injury to surgery was 5 days with a range of 2 to 10 days. The operative time ranged from 45 minutes to 120 minutes. Patients were followed up from 01 to 24 months. 6 were closed and 14 were open fractures Successful fracture union was defined as complete bridging callus in three cortices, together with painless full weight bearing Functional outcome was rated as per The modified ankle score of Olerud and Molander, we got excellent results in 10 cases, good in 07, fair in 02 and poor in one patient.

3.1 Observation and results

Table 1: Distribution of sample by age

Age (Years)	Frequency	Percentage (%)
18-30	1	5
31-40	3	15
41-50	7	35
51-60	4	20
61-70	5	25
TOTAL	20	100

Table 2: Distribution of sample by sex

Sex	Frequency	Percentage
Male	11	55
Female	9	45

Table 3: Distribution of sample by side

Side	Frequency	Percentage (%)
Right	12	60
Left	08	40

Table 4: Distribution of sample by mechanism of injury

Mechanism of Injury	No. of Case	Percentage (%)
Road traffic accident	13	65
Fall from height	07	35
Total	20	100

Table 5: Relationship between sex and the cause of fracture

	Road traffic accident		Fall	
Sex	**No.**	**Percent**	**No.**	**Percent**
Male	09	45	02	10
Female	04	20	05	25
Total	13	65	07	35

Table 6: Distribution of sample by type of fracture

Type	No. of Fracture	Percentage
Open	06	30
Closed	14	70

Table 7: Distribution of sample by type of fracture (classification)

Type		No. of cases	Percentage
A	A1	05	25
	A2	-	
	A3	06	30
B	B1	-	-
	B2	02	10
	B3	-	-
C	C1	03	15
	C2	02	10
	C3	02	10

Table 8: Distribution of sample by operative time

Operative Time	No. of Fracture	Percentage
0-45 MIN	02	10
45-60 MIN	06	30
60-90 MIN	09	45
90-120MIN	03	15

Table 9: Distribution of sample by time taken for fracture union

Union (Weeks)	No. of Cases	Percentage
< 16	07	35
18	04	20
20	04	20
22	02	10
>24	03	15

Table 10: Distribution of sample by full weight bearing

Achieved Times (Weeks)	No. of Cases	Percentage
< 16	06	30
16-20	06	30
20-24	06	30
24-28	02	10

Table 11: Distribution of sample by complications

Complication	No. of Cases	Percentage
Stiffness	03	15
Delayed union	02	10
Infection	02	10
Skin necrosis	0	0
Varus angulation	0	0

Table 12: Functional rating as per olerud and molander score

Rating (In Points)	No. of Cases	Percentage
Excellent (90-100)	10	50
Good (70-89)	05	25
Fair (50-69)	04	20
Poor (less than 50)	01	05

Pre op xray: AP view

Pre op Xray: Lateral view

Parts prepared and draped

Placement of locking compression plate

Placement of drill sleeve

Wound closure

1 year follow up Xray: AP and Lateral view

1 year follow up

4. Discussion

Pilon fractures or distal tibial fractures are one of the complex injuries associated with significant soft tissue damage because of subcutaneous natures of bone and high velocities trauma associated with these fractures. Main aim of management is to provide stable fixation of fracture, prevention of further soft tissue damage, infection, nonunion and wound dehiscence [53]. When soft tissue damage is significant, bridging external fixator is considered as superior option as it decreases the excessive soft tissue stripping and provides a temporary stable fixation to skeletal component. Definitive fixation can be planned after resolution of edema and wrinkling of skin is evident. In cases of open fractures primary care is to provide proper wound debridement, tetanus immunization and broad

spectrum antibiotic cover as prevention of infection is the main aim. If there is significant soft tissue loss after debridement, adequate soft tissue cover is difficult in this area hence skin graft and free flap are viable treatment options [54]. Reports in the literature on ORIF of distal tibia or pilon fractures are plagued by wound infection [55-58]. During high velocity trauma the initial injury causes massive soft tissue damage which devitalizes the tissue around the fracture site, in distal tibia the anterio medial aspect is most risk for wound infection and wound dehiscense [59].

Open reduction and internal fixation has shown increased rates of deep infection and wound dehiscence are the major soft tissue complications. Wound debridement, antibiotics, skin grafting, myocutaneous flap and even arthrodesis have a role to play in management [54]. Studies using external fixation techniques reported significant reduction in infection rates [53, 60, 61]. The rate of infection is drastically decreased with the use of minimmaly invasive percutaneous plate osteosynthesis (MIPPO) in comparison with external fixator and ORIF [53, 62]. This is reflected in our results, with only two cases of superficial wound infection, which completely resolved with appropriate antibiotics. Reports suggest that intramedullary nailing has the lowest infection rates compared with other techniques [63] but the technique is associated with other complications such as malunion, fat embolus syndrome, compartment syndrome and anterior knee pain [63]. Angular malalignment and malunion have been reported with intramedullary nailing of these fractures [63]. The studies on external fixator showed complications such as imperfect reduction loosening, malunion and pin tract infections [60, 61].

Open reduction with fixation of plates have reduced rates angular malunion when compared to external fixation [61] or intramedullary nailing but disadvantages of high incidences of infection. AO distal tibial locking plate using MIPPO technique provides a stable and rigid fixation of the fractures minimizes the angulation and malunion without wound complications as in ORIF. The distal tibia plate is pre-contoured to the anatomy of the distal tibia and thus allows placement of the plate without distruption of fracture fragments. The distal end of the plate allows placement of locking screws that provide stability where satisfactory bone purchase is difficult. The threaded holes lock to the locking screw head and minimise plate-bone interface and maintain the vascularity of the fracture site. The proximal combination holes allow insertion of locking or cortical screws where relative or absolute stability can be achieved. Acceptable tibial aligment was 5° of varus or valgus and 10° of recurvatum or procurvatum. All of our patients were found to have acceptable reduction and alignment post operatively and at union. Fracture healing is defined as mature callus formation seen on plain radiograph with pain free full weight bearing. Average fracture healing time was 18.8 weeks post operatively. Assosciated fibula fractures are fixed with one third semitubular plate As it is a rigid fixation, postoperative plaster immobilization was not necessary as ankle stiffness was not a problem, ankle stiffness was only seen in only 3 patients reason due to communited fracture, prolong immobilization and delayed weight bearing.

Weight bearing was delayed till radiological callaus was visible on post operative check x ray on average weight bearing was started on 12th week post operatively and partial weight bearing was started on a average of 6th weeks. Our results are comparable to other studies using the MIPPO technique [52, 64]. Comparing the results with other methods of fixation, our results are better in comparison with ORIF and external fixation. Other complication we found was delayed union which of due to primary bone grafting was not done and due to infection. Primary bone grafting was done in 3 patient where there was communition of fracture fragments and bone loss. All patients were returned to work in 6 months. 80 % patients felt pre injury status in 6 months.

5. Conclusion

Locking compression plate by mippo technique is an optimal tool for distal end tibia fracture. It provides rigid fixation in the region of distal tibia, where a widening canal, thin cortices and frequently poor bone stock make fixation difficult. Surgical exposure for plate placement requires significantly less periosteal stripping and soft tissue exposure than that of normal plates. Orthopaedic surgeons experience with locking compression plating technique will find it a useful technique. However careful understanding of its basic principles, identification of appropriate fracture patterns for use of LCP is essential to avoid complications like generation of non-union. To conclude, LOCKING COMPRESSION PLATE BY MIPPO is an important armamentarium in treatment of fractures of distal tibia, especially when fracture is severely comminuted and in situations of osteoporosis.

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