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Evaluation of result of minimally invasive plating osteosynthesis (MIPO) technique in the treatment of fracture distal tibia: a prospective follow-up study from Chhattisgarh, India.

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Abstract

Background

High speed motor vehicle accidents are on the rise over the past few years, a major cause of complex fractures of tibia. The main treatment aim of this type of fractures is reinstatement of the normal alignment and articular congruity. Although different surgical techniques are available, but minimally invasive plating osteosynthesis (MIPO) is most popular in minimal articular comminution and damage of soft tissue envelope. MIPO advantages are no periosteal dissections, no disruption of hematoma, stable fixation, early mobilization, less complications and relatively higher rates of union. The main objective of this study was to evaluate the functional and clinical outcomes of distal tibia fracture patients, treated by internal fixation by MIPO technique with locking compression plate (LCP).

Methods

Twenty patients with closed distal tibia fracture with or without intra articular extension treated with MIPO with LCP were prospectively followed for average duration of 18.45 months (range 5-30 months). Fractures were classified according AO classification into broad types.

Results

Average duration of injury-surgery interval was 12days. The age incidence was an average of 38.95 yrs. High occurrence of fracture was seen in labourer (65%), maximum cases (50%) mode of injury was due to road traffic accidents. 75% of the patients showed radiologic union in 13-16 weeks, full weight bearing was achieved in 13-16 weeks. Overall achievement was 75% excellent, 10% good, 10% fair and 5% with poor result.

Conclusion

The present study confirmed that MIPO with LCP is an effective and safe treatment method in terms of union time and complications rate for distal tibia fracture.

Keywords

Distal tibial fracture, LCP, MIPO, osteosynthesis, plating.

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Background

The tibial shaft is one of the most common fractures sites [1]. Treatment of distal tibial fractures has always been challenging due to subcutaneous location of larger portion of tibia, paucity of soft tissue coverage and precarious blood supply to the distal leg [2]. According to the reports, 63% of all open type fractures occur in tibia [3]. In the developing world diaphyseal fractures are declining [4].

Although several classifications have been recommended for fractures but the most useful and worldwide accepted is Arbeitsgemeinschaft für Osteosynthesefragen/Orthopedic Trauma Association (AO-OTA) alphanumeric classification [5]. Several research studies well documented the clinical usefulness of AO-OTA for all long-bonefractures, and other areas [6-8].

There are several causes for tibial fractures, occupation is one of them. A study in West Virginia showed that 55 per 10,000 workers was a victim of occupation involved bone fractures. Logistic regression analysis showed a number of significant independent predictors, namely age, gender, type of occupation, caught in-between objects, fall, struck by or against object, and vehicle collision *etc*. [9]. A study by Appleby *et al*. showed a strong positive association between bicycling and fracture risk: P<0.001 for trend for both genders [10]. Road traffic injures (RTIs) are responsible for a major cause of deaths and injuries. Overall contributory factors are Human behavior, vehicles, and road factors [11]. According to a report, pedestrians are the worst victim of road traffic fatalities (45%), which is relatively less in middle and high-income countries29% and 18% respectively [12].

The most popular choice for the treatment of closed fractures of the tibial shaft is closed reduction and a cast. Healing takes place within 3 to 8 weeks [13]. After 1950, open reduction and internal fixation (ORIF) became a method of choice in selected cases where a sufficient reduction could not be achieved or maintained by conservative means. The main reason to avoid ORIF is extensive dissection and tissue devitalisation, which creates a less favorable situation for fracture union and increases chances of bone infection [14]. So, a number of alternative methods developed with minimal surgical intervention for the treatment of diaphyseal fractures of the tibia.

Currently two methods are gaining popularity, wire fixators and MIPO. Wire fixators are useful in highly comminuted fractures with significant soft tissue damage, whereas MIPO is used when there is minimal articular comminution and minimal damage of the soft tissue envelope [15]. Despite progress of surgical procedures, outcomes are not always satisfactory and complications seenin 20-50% of patients [16, 17]. These two techniques are advantageous because of limited soft tissue stripping, maintenance of the osteogenic fracture hematoma, without interrupting vascular supply to the individual fracture fragments. It also helps to reestablish axial and rotational alignment, gives sufficient stability for progression of motion and eventual return to normal function without any complication.

The purpose of the present study was to evaluate the results of functional and clinical outcomes of distal tibia fracture patients, treated by internal fixation by MIPO technique with locking compression plate (LCP), in the Indian scenario.

Material and Methods

Study Period

The present study was performed during the period of Jan 2012 to Oct 2013.

Study design, participants and the collection of data

The present study was conducted in the department of Orthopaedics, Pt.J.N.M.Medical College, Raipur [Chhattisgarh, India] among the patients attended OPD, IPD and casualty. A total number of 23 patients were included in the study, out of which 3 patients were lost to follow upsurgery done under regional or general anesthesia. Tourniquet was applied as usual manner but inflation was done according to the situation. Incision was done at the level of medial malleolus vertically or curvilinear manner. Hemostat was used for making the subcutaneous plane without striping periosteum and troubling fracture haematoma. Metaphyseal LCP was tunneled into subcutaneous plane. For the fracture reduction we used C arm control.

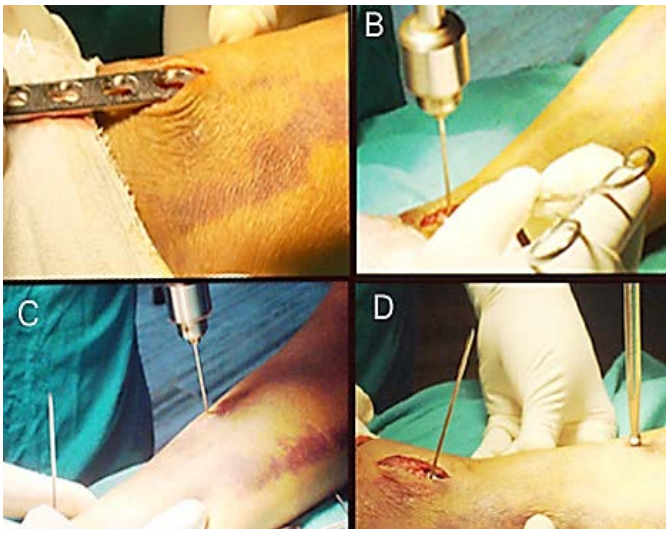

Figure1 –
A:Insertion of LCP through small entry portal by sliding method
B: Lower part of plate fixed by K- wire
C: upper part of plate fixed by another K-wire
D: Both end of plate fixed by screw

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There were some exceptional cases, when it was difficult to reduce fracture by this method, Kirschner wire (3mm) was used as a joystick for this purpose. Towel clip or reduction clamp was applied as usual for holding. Shagging of distal fragment was prohibited by the use of a towel roll under the site of fracture. Afterwards plates were fixed with screws. Provisional non locking screw was used as a routine procedure to bring the plate on the bone. Post-operatively the limb was maintained in the elevated position and firstpost-operative toe-touch weight-bearing with crutches. On second day gentle exercises for the ankle were begun. Three locking screws were used on the either side of fracture with separate stab incision. Non absorbable sutures were used to close the skin. Teeny and Wiss clinical assessment criteria were used finally, for assessing the condition. Interfragmentary compression was done by a screw through the plate or outside the plate. In cases of simple fractures, compression osteosynthesis was adopted by non locking screw, proximal to fracture site as a hybrid fixation. Anteroposterior and lateral views of radiographic images were taken in an interval of 2 weeks, 6 weeks and 3 months. Partial weight-bearing started by 6 weeks. In this research, unique study identification number was used.

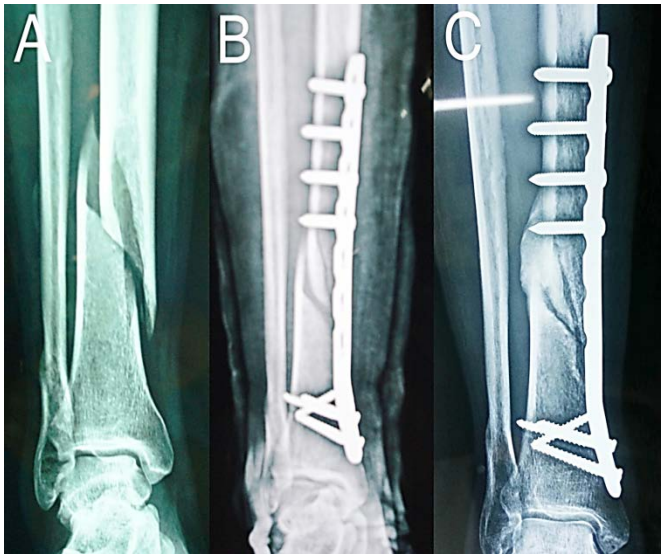

Figure 2 –
A: Pre-operative X-ray
B:Post-operative X-ray
C: 6 month follow-up, X-ray showing radiological union

Response Rate
Among the 23 patients, three were lost to follow up surgery done under regional or general anesthesia giving an overall response rate of 86.95%.

Inclusion criteria
Patient included for study having clinically fracture of distal tibia with or without intra-articular extension. Patient in adult age group 20years and above were considered. Patient with close as well as fresh open fracture presented within six hour of injury included. Cases of polytrauma and patient with minor head injury not requiring neurosurgical interventions were a part of this study.

Exclusion criteria
Patient excluded from study were open fracture except grade 1. Severe systemic illnesses, contraindication for surgery. Local skin infection around potential portal site.

Ethical committee approval
Informed consent were obtained from the patients/parents or guardian. The study protocol and informed consent were approved by the Institutional Ethics Committee of Govt. Medical College (Pt JNMC) Raipur, Chhattisgarh (memo nomcr/ethics comm./13/256). Study, was conducted according to the guidelines for human experimentation established by the Declaration of Helsinki.

Outcome variable
Fracture reunion result, different types of post-surgical complications like superficial wound infection, surgical wound breakdown with implant exposed, prominent hardware *etc.*

Explanatory variables
The demographic factors age, gender, occupation were set as explanatory variables.

Data management and statistical analysis
The data collected was analyzed using Statistical Package for the Social Sciences (SPSS) for Windows Version 16.0 (SPSS Inc; Chicago, IL, USA).

Results

The age incidence in our study shows an average of 38.95years (20to 67years). Among the patients, 15(75%)were males and 5 were females (25%).Site of injury was highly associated with left side (60%).Occupation was a prime factor for fracture, especially in more mobility like labourer(around 65%). RTA wasaccounted for maximum cases (50%) for the injury. The fractures were classified according to AO classification into broad types shown in table1.

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Table 1 - Type of Tibial Fractures	
Type of fracture	**No of cases (%)**
Type A	17(85)
Type B	2(10)
Type C	1(5)
Total	20(100.00)

Majority of the cases were of type A (85%), followed by type B and C. Average trauma surgery interval in our study was 12 days (range 2 – 22 days).

We followed the patients at 3rd, 6th, 12th weeks interval and there after every three months. The minimum follow up period was 6 months to the maximum of 22 months, and was utilized for the analysis of final result.

In our study 75% of the cases showed radiologic union in 13-16 weeks while in the remaining cases it was in 17-20 weeks. In our study full weight bearing was achieved in 13-16 weeks in 75% of the cases and in 17-20 weeks in the rest. During follow-up visit, Clinical assessment was done as per Teeny and Wiss criteria, the clinical rating system along with assessment for fracture union. Upon the analysis of scores obtained in various fracture type the results obtained were shown in table 2.

Table - 2 Different types of fracture reunion result (Teeny and Wiss criteria)				
Results	**Type A**	**Type B**	**Type C**	**Total (%)**
Excellent	13	2	0	15(75%)
Good	1	0	1	2(10%)
Fair	2	0	0	2(10%)
Poor	1	0	0	1(5%)

Most of the fracture reunion results were excellent result (75%), followed by good and fair result (10%).

Table 3 - Post surgical complications	
Complications	No. of cases (%)
Superficial wound infection(managed conservatively)	2(10)
Surgical wound breakdown with implant exposed	1(5)
Prominent hardware (asymptomatic)	1(5)
Normal	16(80)
Total	20(100.00)

Post-surgical complications faced during the study were presented in table 3. Majority of the cases were normal, only few cases (10%) showed superficial wound infection. In our study all fractures united well in time without a single case of nonunion.

Discussion

High speed motor vehicle accidents are on the rise over the past few years, a cause of complex fractures of tibia. Operative treatment is indicated for most tibial fractures caused by high energy trauma. A vast majority of these fractures are unstable, comminuted; coupled with varying degrees of soft tissue damage. To avoid immobilization related complications in future and soft tissue access, surgical intervention is mandatory [18].

Although there are several surgical techniques adopted for the treatment of distal tibia fracture, but perfect fulfillment always remain a challenge to the orthopedic surgeons. Each of it has its own drawbacks. Malunion and implant failure may happens in interlocked intramedullary (IMIL)nailing [19], ORIF with conventional plate also have chances of infection, problems of nonunion and delayed union. Similarly external fixators may cause higher rate of infection, implant failure and malunion or non union; so it is recommended for temporary method of stabilization in open fracture with severe soft tissue injury [19,20]. In MIPO technique, percutaneously inserted plate is fixed at a distance proximal and distal to the fracture site with minimal exposure and relatively less complications.

Influence of age & gender in tibial fracture

The age incidence in our study shows an average of 38.95 years (range 20to 67years) which is lower than that reported by various other studies [21-23]. Gender distribution in our study showed more males (75%) and 5 females (25%) similar with other studies, where males predominated [20,22, 23]. This could be due the fact that a vast majority of Indian female population work indoor, which minimizes the risk of road traffic accident (RTA) associated injuries or fractures.

Occupation as a risk factor

Distal tibia fractures were most commonly seen in people with high level of activity, travel *etc*. In our study majority of cases had been seen with people who have high mobility like, labourers (65%) in comparison to house wives (25%), and shop keepers (5%) as they have low activity level. High energy traumas, RTA predominate in our study causing 50% of the fractures, and have been similarly reported as a major mode of injury by different studies [20,22,24].

AO classification (broad types) was used in the study, and sub types classification was avoidedfor simplicity and small sample size(20cases). The same also been used in other studies [21-23]. Average trauma surgery interval in our study was 12 days (2-22 days) which was comparatively more than other studies [20,22]with an average of 1-10 days. The reason for this was due to delay in making Pt fit for anaesthesia and lack of theater time per day in our institution.Follow up was done at 3rd, 6th, 12th weeks and there after every three months. During follow-up visit, clinical assessment was done as per Teeny and Wisscriteria;the minimum follow up period was 6 month to the maximum of 22 months. Scoring system was similar to other studies [24].

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Success rate in the present study & the earlier works

75% of our cases showed radiologic union within 13-16 weeks while for the rest it was in 17-20 weeks following a similar pattern with earlier works(Table - 4). In our study full weight bearing was achieved in 13-16 weeks in 75% of the cases and 17-20 weeks amongst the rest of the patients. These results were in accordance with other documented studies [20,22-24].Upon analysis of the scores, we were able to achieve excellent result in most of the cases. This was relatively good achievement and can be further improved by preventing the complication which was mainly due to infection. We had compared our outcomes and complications with recent studies revealed in table 4.

Problem of infection was faced by all authors which caused delayed healing andcould be prevented by taking care of infection.Surgery in properly sterilized operation theatre with complete aseptic precaution and dressing of wound, using good antibiotics during healing. In our cases infected wounds were healed by using antibiotics. Second complication was the prominent hardware, which was due to lean and thin patient but not required any treatment because of asymptomatic. Outcome in all the studies showed a good result, 100% union; same as ours. Union times in most studies werein between 12-21weeks similar to ours with short duration. Varieties of approaches were adopted in earlier studies (table 4), such as calcaneal pin traction, external fixators or mechanical distracters to achieve reduction. In our cases we used Kirschner wires (3 mm) as a joystick or a towel clip after making small opening at fracture site; when mechanical traction was insufficient for the reduction. Some of the earlier workers suggested fibula fixations before tibia fixation for the greater success rate of tibial alignment and to prevent valgus malalignment, but this is still under controversy [20, 25].In this present research, there was no routine fixation of fibula unless it had involved syndesmosis. In our case relatively less number of patients was treated with fibular DCP along with tibia fixation.

Conclusion

MIPO with LCP is a near to perfect surgical treatment option for the distal tibia fracture with or without intra articular extension. This could be a best option for management because it is effective, minimal invasive, short operative time, safe and less costly treatment method in terms of union time and complications rate. Our study supports above statement by showing favorable outcome in majority of the cases. Proper sterilization techniques should be adopted side by side which will minimize the risks of infection.

Limitations & future scope of the study

The present study includes a limited number of cases.So, it strongly recommended,conducting broad spectrum multi-centric studies in future including other medical colleges of the state, to obtain a better scenario.

Abbreviations

Arbeitsgemeinschaft für Osteosynthesefragen/Orthopedic Trauma Association (AO-OTA), interlocked intramedullary (IMIL), locking compression plate (LCP), minimally invasive plating osteosynthesis (MIPO), open reduction and internal fixation (ORIF), Road traffic injures (RTIs), road traffic accident (RTA)

Competing interests

Authors declare that they do not have any competing interest.

Table 4 - Comparison of present study with other recent studies

Study	No of fractures	Study Method	Fixation	Outcomes	Complications
Shrestha *et al*. [20]	20	Prospective	MIPO	Union: 20 (18.5 weeks, range 14-28) union20/20(100%)	Delayed union:1, No malunion (≥ 5° deformity or ≥ 1 cm LLD), Superficial wound infection: 2, Deep infection: 1, Secondary procedure: 1
Hazarika *et al*. [23]	20 (open fracture: 8)	Retrospective	MIPO	Union: 18 (28.5 weeks, range, 9–68) Union18/20(90%)	Nonunion: 2, Delayed wound break down: 2, Wound infection: 1, Implant failure: 1, Secondary procedure: 2
Ahmad *et al*. [26]	18	Retrospective	MIPO	Union: 15 (21.2 weeks) Union 15/18(83%)	Delayed union: 3, Superficial wound infarction: 1, Chronic wound infection: 1, Implant failure: 1
Mushtaq *et al*. [27]	21 (open fracture: 4)	Prospective	MIPO	Union: 21(5.5 months, range 3–13) union 21/21(100%)	Delayed union: 1, Non union:1, Wound infection: 2 Secondary procedure: 2
Present study.	20	Prospective	MIPO	Union: 20 (14wks, range 13-16) union20/20(100%)	Wound infection:2, Wound breakdown: 1

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Authors' contribution

Dr. Pravin kumarjangde designed the study, took part in the surgery, interpreted the data, drafted the manuscript, and revised it. Dr. Mukeshdhruw formulated and analyzed the data. All authors took part in critical revision and finally approved the manuscript.

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