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Comparative study of functional outcome of minimally invasive plate Osteosynthesis versus open reduction and internal fixation with locking compression plate in distal 1/3rd shaft tibia fractures (Extraarticular)

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Abstract

Background: The present study was a prospective, interventional and randomized study that was conducted on total of 30 patients with distal 1/3rd shaft tibia fractures (extraarticular) in Department of Orthopedics, GMC and RAJINDRA HOSPITAL Patiala after fulfilling the inclusion criteria.

Materials and Methods: The patients were divided into two groups randomly i.e., group A and group B with 15 cases in each group. Patients in group A were treated with open reduction and internal fixation (ORIF) with locking compression plate (LCP) technique and patients in Group B were treated with minimally invasive plate Osteosynthesis (MIPO). Cases were evaluated and compared as per loss of blood, operative time, fracture union time and time taken for recovery to work. Functional evaluation was done as per Tenny and Wiss criteria.

Results: In the ORIF group, ten cases got excellent grading while three were good, one fair and one poor. Whereas ten cases got excellent and five fair grading in the MIPO technique group.

Conclusion: As per our conclusion, ORIF and MIPO techniques for extra articular fracture distal 1/3rd tibia (AO type A) did not have significant differences in functional outcome.

Keywords: ORIF, MIPO, LCP, Distal 1/3 rd. tibia, extra articular

Introduction

Distal tibia fractures are primarily located on with in a square based on the width of the distal tibia without intra articular extension. These are often caused by high energy axial compressive, direct bending or low energy rotation forces. These fractures constitute less than 7% of all the tibial fractures. Tibial fractures have bimodal distribution with low energy spiral pattern being more common in patients over the age of 50 years and high energy transverse and comminuted fractures being more common in patients around 30 years of age. High energy fractures are more common in males than females ^[1]. The management of unstable distal tibia fractures remains challenging for surgeons. The proximity of the ankle makes the surgical treatment more complicated than midshaft tibia fractures. Treatment selection is influenced by the proximity of the fractures to the plafond, fracture displacement, comminution and injury to the soft tissue envelope. Conventional open reduction and internal fixation (ORIF) techniques involve extensive dissection and periosteal stripping, which increase the risk of soft tissue complications. Intramedullary nailing offers less invasive option yet the biomechanical stability of fixation, risk of malunion or nonunion are some causes of concern ^[2, 3]. The minimally invasive plate Osteosynthesis (MIPO) technique has gained prevalence in recent years. This percutaneous plating technique uses indirect reductions methods and allows stabilization of distal tibia fractures while preserving the vascularity of the soft tissue envelope. As a result, the MIPO technique has gradually become the preferred option for some surgeons ^[4-9]. In our study, we prospectively analyzed the cases treated with MIPO or ORIF and the functional results were evaluated by Tenny and Wisscriteria ^[10].



Fig 1: Extra articular fracture distal tibia (AO Type A).

Material and Methods

The study was conducted on 30 patients with distal 1/3rd shaft tibia fractures in the Department of Orthopaedics, Government Medical College and Rajindra Hospital, Patiala. Patients who satisfied inclusion criteria were included in the study after taking an informed consent

Inclusion criteria

1. Patients between the age of 18 to 60 years
2. Patients having closed extra articular fracture over distal 1/3rd of tibia (AO type A) 3 Patients presenting within one week of injury

Exclusion criteria

1. Open fractures,
2. Pathological fractures
3. Intra articular fractures of distal end of tibia

The patients were divided into two groups randomly i.e., group A and group B with 15 cases in each group. Patients in Group A were treated with open reduction and internal fixation (ORIF) with LCP plating technique and patients in group B were treated with minimally invasive plate Osteosynthesis (MIPO) technique.

Procedure

Primary management

Patients were given first aid in the form of Splint age of the limb, anti-inflammatory drugs and analgesics as the need may be. Any accompanying fresh injury or illness was noted and managed accordingly. Radiographic examination was done to assess the type, pattern, extent and displacement of fracture. General physical and local examination was done and noted. Patient were investigated properly for operative and anaesthesia purposes.

LCP with mipo technique

The patient was positioned supine on a radiolucent operating table under spinal or epidural anesthesia. Locking Plate Osteosynthesis was done with the MIPO technique. Vertical incision inclined proximally was made over the medial malleolus measuring about 3 to 4cms with a gentle curve (after provisional fracture reduction), sparing the saphenous vein and nerve. Extraperiosteally a tunnel was made by blunt dissection in right orientation. Using the locking sleeve as a handle for insertion, the plate was tunneled proximally. Using fluoroscopic intraoperative imaging, locking compression plate was adjusted to meet the contours of the bone. Anatomical fracture reduction was achieved by assessing

length, axial and rotational alignment. Plates were held temporarily by K wires whenever required. Varus-valgus angulation of $<5^{\circ}$, anterior posterior angulation $<10^{\circ}$, and shortening of $<15\text{mm}$ were considered acceptable reduction. Sagging of distal fragment at fracture site was prevented by elevating fracture site with a bolster and plantar flexion of foot. A locking cortical or cancellous screw was inserted. Fracture reduction was confirmed and cortical screw was inserted into the proximal diaphyseal fragment which helped the plate to make contact with bone surface. Remaining screws were inserted by stab incisions. Wound was irrigated with saline and closure done in layers. Sterile dressing was done and well-padded posterior splint given with ankle in neutral position.



Fig 2: LCP with MIPO technique



Fig 3: LCP with ORIF technique

LCP with oriftechnique

Distal tibial fractures were treated with medial approach in most of the cases and anterolateral or posterior approach was used depending upon the fracture. Fracture reduction was done either to anatomic reduction aimed at primary bone healing or relative reduction that restores length and bring secondary bone healing. In direct reductions a Lag screw was used particularly in simple fractures which was followed by plating through a larger skin incision since a larger incision is required for direct reduction of fracture site. The fractured ends were cleared of hematoma and debris to allow an anatomic reduction that was typically facilitated by clamp

application. After a lag screw was placed, plate was placed to neutralize the torque around lag screw. Then screws were placed into plate, reduction and placement of plate was checked with C-arm image intensifier.

Associated fracture of fibula (If any) was fixed depending upon the necessity on case to case basis after the tibia fixation.

Postoperative management

Static quadriceps exercises and toe movements, as tolerated were started from 1st postoperative day. Ankle mobilization was started from 3rd postoperative day. Intra-venous antibiotics were given for 3-5 days followed by a course of oral antibiotics for 5 days. Analgesics were given as per need. Suture removal was done on 11th Postoperative day. Protected weight bearing was allowed once signs of progress toward union were evident on radiographs, usually at 6 weeks postoperatively. Full weight bearing was allowed after 10 to 12 weeks, depending on the radiographic signs of fracture healing. X-rays were taken at regular intervals and evaluated for fracture healing, alignment at fracture site & for any evidence of mal-alignment.

Follow up

Patients were followed up for 18 months after operation at regular intervals of 6 weeks, 3 months, 6 months, 9 months, 12 months and 18 months and evaluated as per TENNY and WISS criteria ^[10].



Fig 4: Criteria for evaluation of result

Table 1: Tenny and Wiss Criteria

Rating	Results
Excellent	(>92 points)
Good	(87-92 points)
Fair	(65 - 86 points)
Poor	(<65 points)

Results

In this study, a total of 30 patients were included. 15 (50%) patients were treated with ORIF (group A) and 15 (50%) with MIPO technique (group B). All the thirty patients had AO type A extra articular fracture on distal 1/3rd of tibia

- The average follow up time was 14 months (12 to 18 months) for group A and 14.5 months (12.5 to 18 months) for group B.
- Average hospital stay in group A was 10.2 ± 2.1 days and 8.1 ± 1.3 days in group B.
- Average blood loss (intraoperative and postoperative drainage) in group A was 120 ml and in group B 92 ml.
- 17 (57%) patients presented within 24 hours of injury, 10 (33%) patients reported between 24 to 48 hours, while 3 (10%) patients came after 48 hours of injury.

Out of these, 9 (60%) were males and 6 (40%) females in group A (ORIF) while 10 (67%) males and 5 (33%) females in group B (MIPO).

Out of these 15 (50%) patients were operated between 1 to 5

days of injury and remaining 15 (50%) after 5 days of injury. None could be operated within the golden hours. Time for fracture healing was within 7 months for group A and within 6 months for group B.

Table 2: Showing duration of fracture union

Duration (In Weeks)	No. of patients (ORIF)	No. of patients (MIPO)
15	6 (40%)	6 (40%)
20	5 (33%)	6 (40%)
25	3 (20%)	3 (20%)
30	1 (7%)	0 (0%)
Total	15 (100%)	15 (100%)

There was one case of nonunion and one case of wound infection in group A (ORIF). Group B (MIPO) had no case of wound infection. There were two delayed unions in group A and one in group B. There were one malunion in group B but within acceptable limits. Two cases of local soft tissue irritation developed in group B. There was no implant loosening in either group.

Table 3: Showing complications in ORIF and MIPO techniques

Name of Complication	No. of Patients (ORIF)	No. of patients (MIPO)
Non union	1	0
Mal union	0	1
Implant loosening	0	0
Delayed union	2	1
Wound infection	1	0
Local soft tissue irritation	0	2

Discussion

Wang Cheng *et al.* ^[11] in 2011 concluded that the MIPO technique is an efficient method for treating distal tibia fracture. But in a small sample paired comparison, no significant superiority of MIPO was found over ORIF. Furthermore, the MIPO technique is more challenging than ORIF as it requires closed reduction and management under X-ray control. Compared with MIPO, ORIF should still be considered the gold standard for distal tibia fracture management. We have compared the AO type A distal tibia fractures with MIPO and ORIF techniques and found no significant differences in fracture healing time, though a small sample size can be considered as a limitation of study.

Vidovic D *et al.* ^[12] in 2015 in their study concluded that MIPO is a reliable method of treatment for distal tibial fractures; it provides a high union rate and good functional outcome with minimal soft tissue complications. Skin impingement remains a common complication with MIPO but can be solved by timely plate removal. The average time for fracture union was 19.7 weeks (Range 12 -38 weeks). In the current study, in group A (ORIF), ten cases (10 out of 15, 66.6%) had functional evaluation of excellent, while three were good, one fair and one poor. In group B (MIPO), ten cases (10 out of 15, 66.6%) were evaluated as excellent and four as good and one as fair. Two cases of group B (MIPO) had local soft tissue irritation, but were managed conservatively.

Galal Hegazy *et al.* ^[13] in 2015 concluded that distal tibia fracture with or without intra articular extension is one of the difficult fractures to manage with all currently available treatment options. Their case series though small in number showed that MIPO with LCP was an effective treatment method in terms of union time and complications rate which

was comparable to other studies. In the present study, MIPO technique obtained comparable results as with ORIF in terms of fracture healing time but delayed union was reported in two cases with ORIF while only one with MIPO. As absolute anatomical reduction cannot be achieved in all cases by MIPO hence the fracture healing time can be longer as compared to ORIF.

Ajeet Dhakar *et al.* [14] in 2016 concluded that MIPO with locking plates for distal tibia fractures is associated with good functional outcomes and is an effective treatment for distal tibia fractures. In their study, 50 fractures of distal fourth fractures of tibia in adults were surgically managed by MIPO. Average union time was 20.96 weeks. The fractures united in 48 (96%) patients with 2 (4%) case of delayed union which took 30 weeks of time period for the radiological signs of callus formation. In our study upon 30 patients, delayed union was observed in two cases with ORIF and one case with MIPO technique.

Shah B M *et al.* [15] in 2019 in a study for treatment of distal tibia extra articular fractures obtained good functional outcome with CRIF by MIPO technique, though two cases developed infection. We obtained excellent functional outcome in 10 cases (66.6%) each, both in group A and in group B.

Conclusion

MIPO technique preserves extra osseous blood supply, respects Osteogenic fracture hematoma, provides biological friendly and stable fixation. Thus, it helps in maintaining soft tissue scaffold and fracture healing yet MIPO technique requires a greater surgical skill and guidance of intra operative fluoroscopic control. Though in the learning stage it can require a longer operative time yet the overall blood loss and hospital stay is less with MIPO than with ORIF. As absolute anatomical reduction may not be achieved in all cases as compared to ORIF hence the fracture healing time may be longer with MIPO technique in a few cases. This can as well predispose to malalignment and hence malunion in some cases. Hence extra articular fractures of distal 1/3 tibia (AO type A) can be treated with both MIPO and ORIF techniques, yet a comparative smaller incision, lesser surgical blood loss and a lesser hospital stay with MIPO can obtain a better functional rehabilitation of the injured. A careful selection of the case along with experience of surgeon may be a deciding factor in selecting the technique for surgery and obtaining the highest degree of functional outcome.

Limitations of study

1. Study sample size is small.
2. Majority of patients were uneducated, hence immobilization by a below knee pop cast was given where deemed necessary.
3. Newer intra medullary nails with many distal locking options may also be compared with MIPO by LCP for extra articular distal 1/3rd tibia fractures.
4. To compare difficulties in implant removal, a longer follow up time is required.

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Conflict of interest: None

Consent of patients: Taken

Ethical committee approval: Taken

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