

Original Article

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Outcome of Minimally Invasive Osteosynthesis of Distal Tibial Fractures Using Anterolateral Locking Plate

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Abstract

This prospective interventional study was conducted in the Department of Orthopaedics, Jalalabad Ragib Rabeya Medical college Hospital and other Private Hospital in Sylhet during January 2019 to December 2020 with a view to evaluate the outcome of Minimally invasive osteosynthesis of Distal Tibial fractures using anterolateral locking plate of distal tibial fracture. For this purpose 21 patients with fracture distal third of tibia were selected. The mean age of the patients was 43.9(SD±8.8) years, 12 (57.1%) male and 9 (42.9%) female with a ratio of 4:3. Total operation time was 71.1(SD±6.1) minutes and time of union was 15.5(SD±2.8±1) weeks. Functional outcome was excellent (66.7%), good (14.3%), fair (9.5%) and poor (9.5%). The final outcome was satisfactory in 80.9% and unsatisfactory in 19.1% of patients. So, Minimally invasive osteosynthesis of distal tibial fractures using anterolateral locking plate is an effective surgical option for achieving satisfactory and functional outcome.

Key words: Distal tibia fracture, Minimally Invasive Plate Osteosynthesis (MIPO), Locking compression plate (LCP)

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Introduction

Fractures of the distal tibia can be challenging to treat because of the limited soft tissue, the subcutaneous location, and poor blood supply. The best treatment option remains controversial. Nonsurgical treatment is possible for stable fractures with minimal shortening, but malunion, shortening of affected leg, limitation of range of motion, and early osteoarthritis of ankle joint. Surgical fixation of distal tibia fractures can be difficult, and requires careful preoperative planning.

Fracture pattern, soft tissue injury, bone quality influence the selection of fixation technique¹. Severe surgical methods have been described, including external fixation, intramedullary nailing, and plate fixation. External fixation can be useful in open fractures with soft tissue which preclude nail or plate fixation, but may result in inaccurate reduction, a relatively high rate of malunion (range 5%-25%) or non-union (range 2%-17.6%), and tract infection (range, 10%-25%). In diaphyseal fractures of the tibia, intramedullary nailing allows relatively a traumatic closed stabilization. It preserves the vascularity of the fracture site and integrity of the soft tissue envelope. However, stable intramedullary nailing of the tibia may be difficult to achieve because the hourglass shape of the intramedullary canal prevents a tight endosteal fit and compromises torsional and angular stability. Secondary displacement of the on insertion of the nail, breakage of nails and locking screws (range 5%-59%), and malunion of the tibia (0-29%)² are potential risks. Classic open reduction and internal plate fixation require extensive soft tissue dissection and periosteal stripping even in expert hands, with high rates of complications, including infection (8.3%-23%)³ and delayed union and nonunions

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(range 8.3%-35%)⁴. Several minimally invasive plate osteosynthesis techniques have been developed, with union rates ranging between 80% and 100%^{5,6,7,8}. These techniques aim to reduce surgical trauma and to maintain a more biologically favourable environment for fracture healing. Nevertheless, complication, such as angular deformities greater than 7° (7.1-35)⁷, hardware failure (range 0-10%) nonunion (range 0-20%)^{5,6} have been reported.

A new advance in this field is represented by the 'locked internal fixators'. These devices consist of plate and screw systems where screws are locked in the plate at a fixed angle. Locking screw minimizes the compressive forces exerted by the plate on the bone because the plate does not need to be tightly pressed against the bone to stabilize the fracture. Minimizes disturbance of the blood supply^{9,10,11,12} will require future confirmation. This system works as flexible elastic fixation that stimulates callus formation. The anatomical shape prevents primary displacement of the fracture caused by inexact contouring of a normal plate, and allows a better distribution of the angular and axial loading around plate^{10,11}. These biomechanical advantages as contrasted to other approaches have not confirmed in clinical follow up studies. We there assessed the union rate, deformity, leg length discrepancy, gait and ankle range of motion, return to preinjury daily and sports activities, and infections and other complications. We compared our results with those reported by other authors using the same technique to evaluate whether the LCP is a suitable device for surgical treatment of distal tibia fractures.

Materials and methods

This prospective interventional study was conducted in the department of orthopaedics, Jalalabad Ragib- Rabeya Medical College Hospital, Sylhet and Other Private Hospital in Sylhet. A total of 21 patients with closed distal tibial shaft fracture were selected during study period from January 2019 to December 2020 according to inclusion and exclusion criteria. Inclusion criteria were unilateral closed displaced fracture shaft of distal tibia at least 5 cm from the tibial plafond, comminuted and segmental fractures, less than 30 days, aged 20

to 65 years irrespective of sex. Exclusion criteria were open fractures of tibia, polytrauma and associated medical problem such as diabetes mellitus, any malignancy and neuro-psychiatric disorder.

Informed written consent was taken from each patient as well as his/her responsible guardian. Immediate skeletal stabilization was achieved by splints with a long leg back slab. All patients were assessed before operation from history, physical examination and necessary investigations. After a complete pre-operative evaluation and proper antibiotic prophylaxis (Preoperatively, cefuroxime 1.5 gm followed by two additional doses during the first 24 hours). During operation, the patient supine on a radiolucent table, and standard intraoperative fluoroscopy used throughout the procedure. Using manual traction at the ankle, the fracture was gently reduced, restoring limb length, alignment and rotation. Most often, we internally fixed the tibial fracture only when fibular fracture its mid shaft or proximal third. If fibular fracture is distal third and ankle mortise is distorted then we fixed fibula first using one third fibular plate by open method to provide lateral stability, restore the correct length and avoid over distraction at the fibular fracture site. The main fracture fragments of the distal tibia were aligned and reduced percutaneously or separate stab incisions using a periosteal elevator, clamps, or Kirshner wires as joysticks, and then fixed with individual lag screws. A longitudinal skin incision was made anterolaterally about 3-4cm in length. Muscle and ligament were retracted and tunnel was produced using a periosteum elevator. Following appropriate reduction of the fracture, a locking compression plate-distal tibial plate (LCP-DTP) was inserted to bridge the fracture site. We chose a plate long enough to bridge the metaphyseal zone and allow the insertion of at least two bicortical screws proximal to the fracture. Lastly wound was closed.

All the Patients internal fixation were kept in observation ward for next 24 hours. The operated limb was kept partially elevated with a pillow, static quadriceps exercise begun as soon as pain subsided. The patients were allowed to walk with double crutches or walker after 24 hours. Stitches were removed at 10-14 days.

Patients were follow up at 2 weeks, 4 weeks, 8 weeks and 12 weeks and every 3 months thereafter until union was completed. Each patient was evaluated clinically and radiologically. The functional ability in the form of pain on full weight bearing, range of movement of the knee and ankle, amount of shortening of the limb, alignment or angular deformity of fracture site at healing, fracture healing without infection was expressed as excellent, good, fair and poor according to the criteria followed by gastillo¹³. Data were processed and analysed by SPSS. Quantitative data were analysed by mean and standard deviation while qualitative data were analysed by rate, ratio and percentage.

Results

The age of patients of fracture distal third of shaft of tibia was ranging from 20 to 60 years with the mean age 43.9 (SD±8.8) years; most of the patients (83.3%) were at or below 50 years indicating middle age group was more affected in fracture distal third of the tibia. There were 12(57.1%) male and 9(42.9%) female with a ratio of 4:3. Cause of injury was road traffic accident (RTA) 11 (52.5%) assault in 2 (9.5%), and occupational injury and fall from height each constituted 4(19%) of patients. Fracture configuration was in spiral in 12 (57.1%), oblique in 6 (28.6%), transverse in 2(9.5%) and segmental in 1 (4.8%) patients. The duration of fracture ranged from 5-14 days with the mean 9.6 (SD±3.8) days. Baseline characteristics of the patients is shown in table -1.

Table-1 Baseline characteristics of the patients(n=21).

Baseline characteristics	Frequency	Percentage
Age(years)		
21-30	2	9.52 %
31-40	6	28.57 %
41-50	9	42.85 %
51-60	3	14.28 %
Mean		
Sex		
Male	12	57.1 %
Female	9	42.9 %
Cause of injury		
RTA	11	52.5 %
Assault	2	9.5 %
Occupational injury	4	19 %
Fall from height	4	19 %
Pattern of Fracture		
Spiral	12	57.1 %
Oblique	6	28.6 %
Transverse	2	9.5 %
Segmental	1	4.8 %
Duration of Fracture(Days)	9.6 SD±3.8	

The total operation time ranged from 60-80 minutes with the mean 71.1(SD±1) minutes. Time of union ranged from 12-20 weeks with the mean 15.5 (SD 2.8±1) weeks. The duration of hospital stay ranged from 5-8 days with the mean 6.2(SD±1) days.

Total postoperative complication were in 4(19.1%) patients,(Figure-1). The individual post-operative complications ankle pain[5 (23.7 %)], superficial infection[1 (4.8%)] ,flexion deficit ankle <10°[11(52.4%)] , flexion deficit ankle >10° [4(19.1%)] (Table-II).

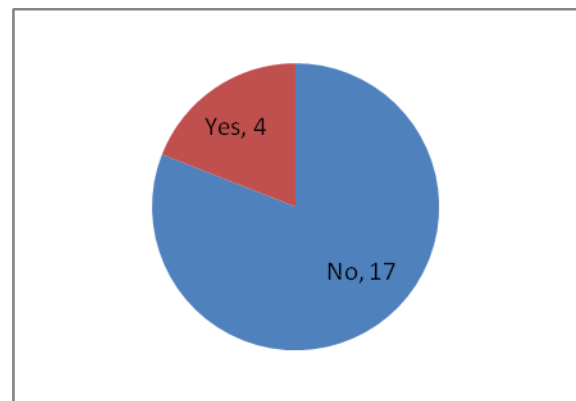


Figure-1: Distribution of patients by total post operative complication.(n=21)

Table-II: Distribution of respondents by different types of post-operative complications (n=21).

Type of complication	Frequency	Percentage
Ankle pain	5	23.7%
Superficial infection	1	4.8%
Flexion deficit ankle <10	11	52.4%
Flexion deficit ankle >10	4	19.1%

Functional outcome was excellent in 14 (66.7%), good in 3 (14.3%), fair in 2 (9.5%), and poor in 2 (9.5%) patients (Figure-2).

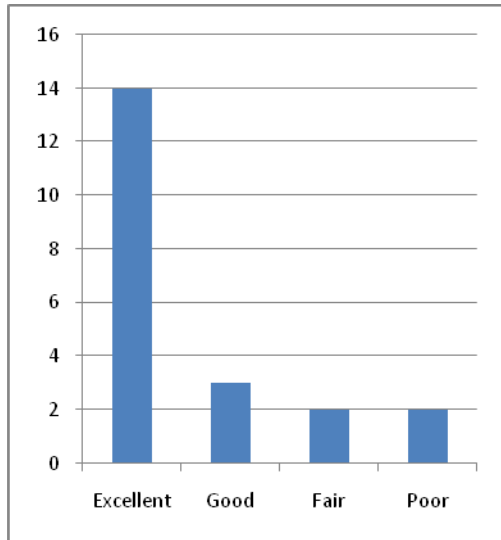


Figure-2: Distribution of patients by functional outcome (n=21) Final outcome was satisfactory in 17 (80.9%) and unsatisfactory in 4(19.1%) patients (figure-3).

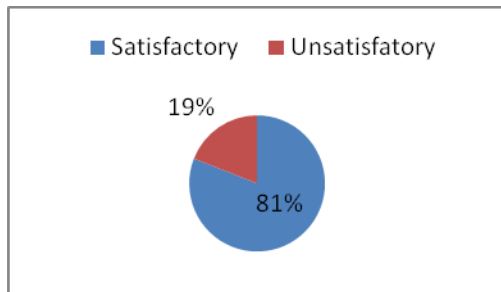


Figure-3: Distribution of patients by final outcome (n=21)



Fig: 4 –Preoperative X-ray showing fracture distal third of tibia



Fig: 5 – Postoperative X ray



Fig: 6 – Postoperative X ray after 12 weeks

Discussion

The treatment of distal fractures can be challenging because of limited soft tissue, the subcutaneous location of the bone, and poor vascularity. By minimally invasive plating techniques iatrogenic soft tissue infection and

non-union can be reduced^{6,7}, but several complications such as angular deformities greater than 7° and hardware failure have been reported in several studies^{5,6,7}. To overcome these limitations locking plates have been developed. We therefore evaluate the bone union rate, deformity, range of motion of the ankle, and infection or other complications rate after locking plating by using a group of patients with closed distal tibia fracture.

In this study the age of patients of fracture distal third of tibia was ranging from 20 to 60 years with the mean age 43.9(SD±8.8) years. This result was supported by other studies^{6,14}. The present study also showed that most of the patients (83.3%) were at or below 50 years indicating middle age group were more affected in fracture distal third of shaft of tibia. This study showed that there were 12(57.1%) male and 9 (42.9%) female with a ratio 4:3. This result was almost similar to some other studies^{6,14}. Male being the major working group in our society and thus are more consistently exposed to the external environment that may be the cause of male predominance.

The study showed that cause of injury was road traffic accident (RTA) in 52.5% of the patients, assault in 9.5%, and occupational injury and fall from height each constituted 19% of patients. Several studies supported these findings⁶. The duration of total operation time ranged from 60-80 minutes with the mean 71.1(SD±6.1) minutes. In this study, the time of union ranged from 12-20 weeks with the mean 15.5(SD2.8±1). This result was supported by some other studies⁶. Post-operative complications were in 4 (19.1%) patients. The individual post-operative complications knee pain [5(23.7%)], superficial infection [1(4.8%)], flexion deficit ankle <10° [11(52.4%)], flexion deficit ankle >10° [4(19.1%)]. The duration of hospital stay ranged from 5-8 days with the mean 6.2(SD±1). Devendra et al¹⁴ found that patients stayed in the hospital for Minimally invasive osteosynthesis of distal tibial fractures using anterolateral locking plate group was 6 days (range 3 to 9 days).

In the current study outcome was excellent in 14 (66.7%), good in 3 (14.3%), fair in 2 (9.5%) and poor in 2 (9.5%) patients. In this regards

Vasu et al¹⁵ in their study minimally invasive plate fixation of the distal tibia reported excellent results in 11 patients, good in 9, fair in 2 and poor result in one patient.

Minimum sample was taken in this study. Sample size in this study was limited due to limited study period. Minimally invasive antero-lateral plate fixation done in distal tibia fracture was done due to availability of C-arm and daily operation facilities in the study place.

Conclusion:

The minimally invasive plate osteosynthesis technique is a better fixation technique for fractures of the distal third of tibia, which preserve most of the vascularity of bone and fracture haematoma and thus providing for more biological environment for repair. Universal bone healing can be achieved with this type of fixation. This technique can be used in fracture where nailing cannot be done like distal tibial fractures with small distal metaphyseal fragments and markedly comminuted fractures. There is lesser incidence of delayed union and non-union because of preserved vascularity. There was reduced incidence of infection due to limited exposure. Infection can also be prevented by careful handling of the soft tissues and by minimising the operating time. Small numbers of patients in our study, we cannot draw any definitive conclusions. The cost of the locking plates, the technically demanding nature of the procedure, and the increased exposure to radiation during the procedure should be considered when comparing the efficacy of this device to the normal plates. Only future prospective randomized studies may be able to clarify these issues.

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