ORIGINAL RESEARCH PAPER

Orthopaedics

A PROSPECTIVE STUDY OF SURGICAL MANAGEMENT OF DISTAL TIBIA FRACTURE WITH ANTEROLATERAL LOCKING COMPRESSION PLATE

KEY WORDS: Distal tibia fractures; Locking Compression Plates; Anterolateral LCP.

Mohammad Rashid* *Corresponding Author

Devashish Mendiratta

Shakeeb Mohammed Shariff

Rajendra Pranav

ABSTRACT

Distal tibia fractures remain one of the most substantial therapeutic challenges that confront the orthopaedic surgeon. Numerous features are responsible for this, but perhaps none are as difficult as the accompanying soft tissue injury that is frequently present. Despite the advances in the identification, understanding, and treatment of the concomitant soft tissue injury, the liberal use of computed tomographic (CT) scanning, advances in implant design including locking plate technology, and minimally invasive application techniques, satisfactory outcomes for the management of these challenging fractures remains elusive.

Objectives of the study

1. To evaluate the functional outcome after using Anterolateral Locking Compression Plate in distal end of Tibia fractures.
2. To assess the union of fractures after internal fixation.
3. To assess the complications after using Anterolateral Locking Compression Plate.

Result

All cases were followed up for a period of 12 months and the functional outcome was assessed by the American Orthopaedic Foot and Ankle Society Score. 75% patients achieved good to excellent outcome with a mean AOFAS score of 81.95 One patient had superficial infection which was treated with a course of antibiotics and regular dressings. One patient had implant failure at five months post surgery. One case of non union was seen.

INTRODUCTION

During current times, the increasing incidences of road traffic accidents are responsible for a great percentage of human mortality and morbidity. Among the various injuries occurring as a result, distal tibia fractures are one of the most therapeutically challenging. Due to increasing life expectancy, there is a rise in the elderly population which has led to increased incidence of these fractures in osteoporotic bones adding to the morbidity. These fractures are relatively rare, accounting for only 3% to 10% of tibial fractures and less than 1% of all lower limb fractures.[1,2] After diaphyseal fractures the highest incidence of open fractures occur in the tibial plafond.[3] Low energy fractures occur in old age group due to rotation injury resulting in extra articular fractures without much soft tissue injury with fewer incidences of wound complications and infections. High energy fractures occur in the younger age group due to axial loading resulting in comminuted intra articular fractures with severe soft tissue injuries, edema and skin blisters around the ankle which makes the decision regarding management difficult.

The management of distal tibia fractures has been a serious concern for orthopaedic surgeons. The subcutaneous location of the anteromedial surface of tibia means that severe bone and soft tissue injury is not infrequent and there is a high incidence of open fractures compared to other long bones.[4]

Regaining full range of ankle movement is often difficult as the fractures are in close proximity to the ankle. Fracture comminution, open injuries, soft tissue injuries, intra articular extension of fractures leads to unsatisfactory outcomes regardless of the chosen treatment modality.

Open reduction and surgical fixation, study of injury patterns, better implants and post operative physiotherapy help in attainment of better functional outcomes for the patient.

Major concerns during the treatment of distal tibia fractures are

- Comminution of metaphysis and intra articular extensions of fractures make anatomical reduction difficult
- Increased incidence of compound injuries
- Poor soft tissue coverag
- Wound dehiscence post operatively

In comminuted fractures achieving rigid fixation is difficult due to poor purchase. Metaphysis comminution is associated with less satisfactory results due to early loosening of implant. The fixation is thus less satisfactory. This prevents early weight bearing and mobilization of the patient.

Treatment selection is influenced by proximity of the fracture to the ankle, comminution, fracture displacement, and injury to soft tissue.[5] Most fractures at this site need to be fixed because non operative treatment leads to loss of reduction and malunion.[6]

Variety of options are available for the treatment of these fractures.[6,7,8] The options include

- Interlocking intramedullary nailing
- External fixators
- Conventional plating with dynamic compression plating
- Locking compression plates

These different techniques have their own merits and demerits.

Distal tibia fractures often make the use of interlocking

intramedullary nails arduous as distal locking becomes difficult. Conventional osteosynthesis with plates is usually associated with high rates of infection, wound dehiscence, delayed union or non union which often require secondary procedures like bone grafting, debridement or implant removal. Pin track infection, pin loosening, osteomyelitis, delayed union, non union make external fixators a poor choice as a definitive fixation option.[5]

Open reduction and internal fixation has recently gained popularity due to better assessment of soft tissue envelope and development of locking compression plates.

Locking compression plate device offers potential biomechanical advantage over other methods by,

- Better distribution of forces along the axis of bone
- They can be inserted with minimal soft tissue stripping using minimally invasive percutaneous plate osteosynthesis
- Substantially reducing the failure of fixation in osteoporotic bones
- Reducing the risk of a secondary loss of intraoperative reduction by locking with screws to the plate.
- Unicortical fixation option
- Better preservation of blood supply to the bone as a locked plate does not rely on plate bone compression
- Provide stable fixation by creating a fixed angle construct and angular stability
- Early mobilisation

Two types of locking compression plate can be used in the management of fractures of distal one third of tibia i.e. medial LCP and the anterolateral LCP

Limited literature exists, comparing methods of treatment of distal tibia fractures. Locking and compression plates are well accepted and effective methods, but are historically related to some complications such as infections, wound complications and implant prominence particularly with medial plating. Hence the study was conducted with an objective to evaluate the efficacy of anterolateral locking plates in treatment of distal end tibia fractures.

OBJECTIVES

1.,To evaluate functional outcome after using Anterolateral Locking Compression Plate in Distal End of Tibia Fractures.
2. To assess the union of fractures after internal fixation.
3. To assess the complications after using Anterolateral Locking Compression Plate.

MATERIALS AND METHODS

Source of the data:
This study was undertaken at Department of Orthopaedics, J.J.M. Medical College, Davangere, Karnataka, India. Adults aged above 18years of age with distal tibia fractures admitted to Chigateri General Hospital and Bapuji Hospital attached to J.J.M Medical College, Davangere, Karnataka, India during the period from October 2018 to September 2020.

Method of data collection: 20 cases of distal tibia fractures during the study period were included in study ,and cases were followed up for a minimum period of 12 months at 4,6,9,12,16 weeks and then two monthly follow up till 12 months.

Inclusion criteria:
- Patients with distal tibial fractures
- Age 18 years and above

Exclusion criteria:
- Patients with Open distal tibia fractures
- Patients with pathological distal tibial fractures other than osteoporosis
- Distal tibial fractures with neurovascular deficit and other medical reasons
- Fracture leading to compartment syndrome or impending compartment syndrome.
- Patient not willing to give written consent for study

Duration of study: 2 years.

Period of study: October 2018 to September 2020

Initial management and pre-operative assessment:
A thorough history from patients and attenders followed by a clinical examination was carried out to evaluate skin condition, wound status and ankle stability and the general condition of the patient along with associated injuries. It was followed by radiological assessment. The initial radiographs included Antero-posterior and Lateral view of the entire length of tibia with antero-posterior, lateral and mortise view of ankle joint. Initial management included immobilisation with an above knee POP slab, analgesics anti-inflammatory drugs, limb elevation and monitoring of the patient.

Patients and their families were then explained about the nature of the fracture, prognosis of non-operative and operative treatments and also regarding the need for closed/open reduction and internal fixation in their case. The patient and his/her family members were explained about the study and a written consent was taken if they agreed to be a part of the study.

Routine examination of blood was done for hemoglobin percentage, total and differential WBC counts, fasting blood sugar, blood urea, serum creatinine, bleeding and clotting time, HIV and HbsAg. Examination of urine was done for presence of albumin and sugar. Blood pressure and ECG were recorded in all patients. Preparation of the part was done on the day of surgery. Tetanus toxoid injection and intravenous antibiotic were given to all patients pre-operatively. Physician fitness was obtained for all patients. Consent for surgery was taken and patients were operated after a pre-anesthetic checkup.

Surgical Procedure:
If the patient satisfies the inclusion criteria, a detailed written consent was taken from the patient and the attenders and patient was taken up for the proposed surgery. The patient was operated under spinal anaesthesia. A large sandbag was placed underneath the affected side buttock to internally rotate the leg and bring lateral malleolus forward. The limb was exsanguinated by elevating the limb for 3 to 5 minutes and then tourniquet was applied. Anatomical landmarks were marked. Antero-lateral approach was taken to expose the distal tibia fractures. An approximately 15 cm incision is taken on the lateral aspect of the ankle beginning 5 cm proximal to ankle joint. It is extended proximally if required. The incision is curved downward passing 2 cm medial to tip of lateral malleolus and onto the foot ending medial to fifth metatarsal base. Care must be taken to preserve the superficial peroneal nerve. The internervous plane is created between the peroneal muscles and the extensor muscles. The extensor muscles are retracted medially to expose the anterior aspect of distal tibia. Angular deformity is assessed in coronal and sagittal plane and corrected using a K wire or Schanz pin as a joystick under image intensifier or using a distractor. After exposure of distal tibia the anterolateral plate is placed. The distal end of the plate will be at the level of tibial plafond and proximal end has three to four holes above the fracture site extent. The plate position is checked under image intensifier in both anteroposterior and lateral views. The plate is temporarily fixed with K wires. The plate is then fixed with

locking and cortical screws in the shaft and metaphyseal fragment of distal tibia in accordance with the fracture geometry.

Antero-lateral approach taken over distal tibia.

Placement of the anterolateral LCP over distal tibia.

Fixation of the LCP with locking screws

Post-Operative Management:

Immediate post op limb elevation is given to reduce swelling. Patient is started on intravenous analgesics and antibiotics. On post op day two wound inspection is done and dressing is changed. Post-operative X-Rays are done in antero-posterior and lateral views to assess the reduction.

Patient is encouraged to do static quadriceps exercises and toe movements on post op day 1. Ankle movements are started on post op day 3 onwards. Patient is mobilized with the aid of a walker with strict non weight bearing. Wound inspection if required can be done on post op day 5. Suture removal is done on post op day 10 to 12. Patient is instructed to continue the use of walker with strict non weight bearing.

Follow up protocol :

At 6 to 8 weeks if signs of union are evident patient is encouraged to partially weight bear with the help of walker. Complete weight bearing is started at 10 to 12 weeks depending upon fracture healing. Patient is followed up for an average of 12 months at regular intervals of two months. X-Rays are taken at regular intervals of distal tibia with ankle in anteroposterior and lateral views to assess fracture healing and look for complications like loss of reduction, implant breakage, malalignment. Functional outcome will be evaluated using American Orthopaedic Foot and Ankle Society Score (AOFAS). Radiological outcome will be assessed using Radiological Union Scale in Tibial fracture (RUST) to assess union and malalignment and anteroposterior and lateral plane (6,7,8). Master chart of the data collected will be made and subjected to statistical analysis.

RESULTS

A total of 20 patients of distal tibia fractures were operated upon by anterolateral locking compression distal tibia plate and were followed up for a period of one year. Patients were evaluated at regular intervals and were evaluated in terms of clinical outcome and by radiological parameters. American Orthopaedic Foot and Ankle Society Score (AOFAS) was used to assess the functional outcome of patients and Radiological Union Scale for distal tibia (RUST) was used to assess radiological outcome. The following observations were made upon analysis of the available data.

A total of 20 patient were analysed which included 12 males (60%) and 8 females (40%).

Age distribution showed that 2 patients were in the age group of 30 -39 years ie, 10%. 8 patients , 40% were in the age group of 40 -49 years. 5 patients, 25% were in the age group of 50- 59 years. 2 patients, 10% were in the age group of 60-69 years. 3 patients, 15% were above the age of 70.

Age wise distribution of patients

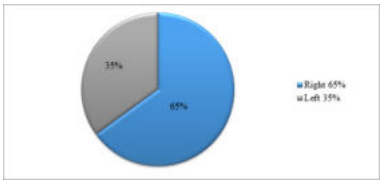
Age groups	No. of patients	Percentage of patients
30-39	2	10
40-49	8	40
50-59	5	25
60-69	2	10
70-79	3	15
Total	20	100
Mean age	52.3	

Mode of injury wise distribution of patients

Mode of injury	No. of patients	Percentage of patients
RTA	13	65
Fall of heavy object	5	25
Self fall	2	10
Total	20	100

65 % of the injuries of the distal tibia occurred as a result of road traffic accidents. 5 patients- 25% injured their distal tibia due to fall of heavy objects. While 2 patients,10%, had an injury due to slip and fall.

Affected side wise distribution of patients



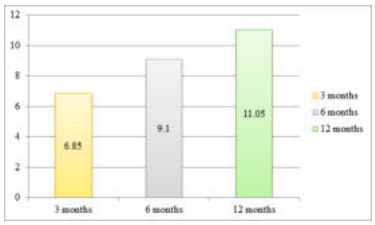
Of the total 20 patients in the study 13, 65% of patients had injured their right tibia and 7, 35% had injured their left side.

AO Fracture classification wise distribution of patients

Fracture classification (AO)	No. of patients	Percentage of patients
A1	1	5
A3	6	30
B2	2	10
C2	4	20
C3	7	35
Total	20	100

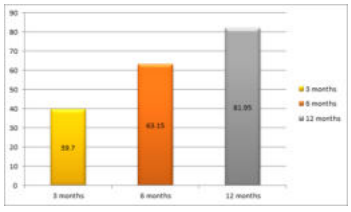
Among the 20 patients under the study, according to AO classification of fractures, 1 patient had A1 type fracture, 6 (30%) had A3 type, 2 (10%) had B2 type, 4 (20%) had C2 type and 7(35%) patients were of C3 type Comparison of

Radiological union score of tibia RUST scores at the end of 3 months, 6 months, and 12 months.



Upon comparison of the RUST scores at 3 , 6 and 12 months, it was found that with time there was an increase in union rate as showed by the increasing values of the mean RUST scores.

Comparison of American Orthopaedic Foot and Ankle Society Scores at the end of 3 months, 6 months, and 12 months.



Upon comparison of the AOFAS scores at 3 , 6 and 12 months, it was found that with time there was an increase in functional outcome as showed by the increasing values of the mean AOFAS scores. The mean AOFAS score at the end of 3 months was 39.7 which increased to 81.95 at the end of 12 months.

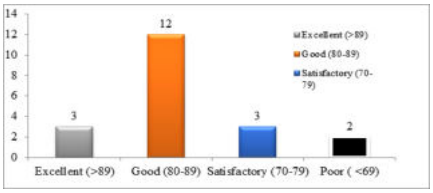
Complications wise distribution of patients

Complications	No. of patients	Percentage of patients
Nil	17	85
Yes	3	15
Total	20	100

Among the 20 patients under study, 3 developed complications. 1 patient had superficial infection on post op day 5. Infection was resolved with a course of antibiotic chosen based on culture and sensitivity report. 1 patient had implant failure five months after surgery. One patient developed non union.

Distribution of AOFAS score with age groups

	No. of patients	Percentage of patients
Excellent (>89)	3	15
Good (80-89)	12	60
Satisfactory (70-79)	3	15
Poor (<69)	2	10



Case

Pre op

Immediate Post op

3 month post op

6 month post op

12 month post op

Range of motion

DISCUSSION

Treatment of distal tibia fractures has always been a challenging task for the orthopaedic surgeons.

In recent times, due to better understanding of soft tissue coverage, anatomy of fractures, better imaging techniques and better implants such as locking compression plates, open reduction and internal fixation has superseded all forms of treatment. Conservative treatment is usually reserved for only those with absolute contraindications for surgery.

The goal of treatment is to obtain anatomical alignment of the joint surface and stability and thus enable early mobilization of patients to reduce complications like ankle stiffness.

Selection of proper implant length and type and number of screws is important for a sound fixation. A high plate span ratio decreases the load onto the plate. A high working length of the plate reduces the screw loading thus fewer screws need to be inserted and the plate screw density can be kept low.

In the treatment of distal tibia fractures usually two types of locking compression plates are used - medial LCP and anterolateral LCP. An anterolateral approach has the advantage of good exposure of the lateral malleolus and distal tibia. This helps the surgeon to better understand the fracture anatomy on table and thus achieve a good anatomical reduction and rigid fixation with the implant. With this approach a precontoured anterolateral locking compression plate can be placed. Good positioning of the LCP in this region is well covered with soft tissue and thus reduces the chances of infection while wound healing.

The present study was conducted to evaluate the operative outcome of treatment of distal tibia fractures with anterolateral locking compression plates.

In our study distribution of patients according to age showed that the age ranged from 35 to 74 years. The majority of the patients were in the age group of 40 to 49 years (40%). The mean age was 52.3 years. In this study 5 patients were above the age of 60 years and some of them had associated comorbidities like diabetes mellitus and hypertension. However none of them developed any wound complications. Similar age groups were seen in studies conducted by Kosalaraman et al12 which included 25 patients with a mean age of 49 years and C.A. Encinas et al13, 40 patients with a mean age of 53 years.

In our study, the gender distribution was of 12 males (60%) and 8 females (40%).

Similar studies had a relatively higher percentage of male patients such as Kosalaraman et al12 with 72% males and Vinod Nair et al10 with 84% males.

The most common cause for the distal tibia fractures in our study was road traffic accidents. 13 out of 20 patients were involved in road traffic accidents. 5 had suffered injury due to fall of a heavy object. And 2 patients had a slip and fall. These findings were in congruence with similar studies indicating that with modernization, road traffic accidents are the leading cause of high velocity trauma in individuals.

In our study, 35% of fractures were extra articular, 10% were partially intra articular, and the rest 65% were intra articular..

Our study was comparable to the study sample of Devendra Lakhotia et al11 which had 62% patients with intrarticular fractures and 38 % patients with extra articular fractures

The average time of union in our study was 19.6 weeks. Similar results were obtained in studies conducted by Bhavin et al9 with 17.6 weeks and Kryzysztof et al14 with an average union time of 19 weeks.

In this study, the functional outcome was assessed with American Orthopaedic Foot and Ankle Society Score at regular intervals of 3, 6, 12 months.

In our study the mean AOFAS score at the end of 12 months was 81.95 3 patients (15%) had excellent outcome, 12 patients (60%) had good outcome, 3 patients (15%) had satisfactory outcome while 2 patients had poor outcome.

Our study showed similar outcomes to studies conducted by Kosalaraman et al12 with mean AOFAS score of 79.16 and Bhavin et al9 and C.A. Encinas et al13 which showed excellent to good outcomes in 80% and 82% of the patients.

In our study of 20 patients one patient (5%) developed superficial infection on post op day 5. Treatment was done with a course of antibiotics and regular dressings and the wound eventually healed with secondary intention. No wound debridement was required. The patient did not have any co morbidities.

The infection rate in various studies conducted on treatment of distal tibia fractures using anterolateral approach has ranged from 4 to 16%.

The low rate of infection in our study can be attributed to the fact that there were no cases of open injury in our study compared to other studies.

In our study there was one case (5%) of non-union and one case (5%) of implant failure. It was comparable to the study conducted by Bhavin et al9 who also had a case of non union (5%) and Kosalaraman et al12 who reported a case (4%) of implant failure in their study due to premature weight bearing.

Limitations of the study

- Small sample size
- Limited follow up
- Not a randomized control study
- No fixed protocol for fibula fixation and was done with different modalities depending on surgeon's preference.

CONCLUSION

In the treatment of distal tibia fractures, the anterolateral locking compression plate seems a reliable option. The anterolateral approach allows proper exposure of the distal tibia and lateral malleolus and thus is effective in understanding the fracture anatomy on operating table. A pre contoured anterolateral locking compression plate can be placed with this approach for the fixation of distal tibia fractures. This approach helps in treating the distal tibia fracture especially comminuted intra articular fractures. A properly positioned plate in this region has adequate soft tissue coverage which reduces the chances of wound breakdown.

The effectiveness of the anterolateral locking compression plate can be judged by the results of the study which showed 75% good to excellent functional outcome with minimal complications.

REFERENCES

1) Rüedi TP, Allgöwer M. Fractures of the lower end of the tibia into the ankle-joint. Injury. 1969 Oct 1;1(2):92-9.
2) Rüedi TP, Allgöwer M. The operative treatment of intra-articular fractures of the lower end of the tibia. Clinical Orthopaedics and Related Research®. 1979 Jan 1(138):105-10.
3) Walker C, Garg A, McQueen MM. Half-ring external fixation in the management of tibial plafond fractures. Journal of orthopaedic trauma. 1999 Mar 1;13(3):200-6.
4) Dr. Lokesh Holagundi, Dr. Deepak S, Dr. Dayanad. Dr. Ramachandra. Functional Outcome with Surgical Management in Distal Tibia Fracture. IOSR Journal of Dental and Medical Sciences. 2014;13 (5):83-90
5) Bedi A, Le TT, Karunakar MA. Surgical treatment of nonarticular distal tibia fractures. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2006 Jul 1;14(7):406-16.
6) David P Barei, Rockwood and Green's, Fracture in adults, 8th edition,vol-2,2473-2540
7) Himanshu.H,Prasad.MB,Verma.AK, Minimally Invasive Percutaneous Plate Osteosynthesis(Mippo) A Technique for Treatment of Distal Tibia Fractures,e-ISSN:2279-0853,p-ISSN:227-0861.Volume 15,Issue 12 Ver.1(December,2016),PP 31-38.
8) Collinge C, Kuper M, Larson K, Protzman R. Minimally invasive plating of high-energy metaphyseal distal tibia fractures. Journal of orthopaedic trauma. 2007 Jul 1;21(6):355-61.
9) Dr Bhavin Agrawal ,Dr Sanjay N.Patil. Surgical outcome of anterolateral plate in distal end tibia fracture. International journal of Scientific Research. Vol 6. Issue 4, April 2017
10) Nair V, Uchale S, Herode PG, Shroff A, Yadav K. Comparative Study between the Role of Medial LCP and Anterolateral LCP in the Management of Fractures of Distal Tibia. Journal of Pharmaceutical and Biomedical Sciences. 2016 Feb 23;6(2).
11) Devendra Lakhotia, Gaurav Sharma, Kavin Khatri, G.N. Kiran Kumar, Vijay Sharma, Kamran Farooque. Minimally invasive osteosynthesis of distal tibial fractures using anterolateral locking plate: Evaluation of results and complications. Chinese Journal of Traumatology. 2016; 19: 39e44.
12) Padmanaban K, Kamalanathan M, Palaniswamy B, Ramasamy V, Cyriac AP. Prospective study of distal tibia fracture with anterolateral plating by MIPPO. Indian Journal of Orthopaedics. 2017;3(2):153-9.
13) C.A. Encinas-Ullán, R. Fernandez-Fernandez, J.C. Rubio-Suárez, E. Gil-Garay. Medial versus lateral plating in distal tibial fractures: A prospective study of 40 fractures. Rev Esp Cir OrtopTraumatol. 2013;57(2):117-122
14) Pi□tkowski K, Piekarczyk P, Kwiatkowski K, Przybycie□ M, Chwedczuk B. Comparison of different locking plate fixation methods in distal tibia fractures. International Orthopaedics. 2015 Nov 1;39(11):2245-51.