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THE CHETTINAD EXPERIENCE WITH FIXED-ANGLE LOCKING PLATE FIXATION FOR FRACTURES OF DISTAL TIBIA

Chander S. G¹, Kanagasarthi K², Balaji Govindarajan³, M. Narayana Reddy⁴

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ABSTRACT: The Surgical treatment of fractures of the distal tibia poses a true challenge to the Orthopaedic Surgeon because of the paucity of soft tissue, their subcutaneous location and poor vascularity. The complications related to treatment are also high. The fixation options are many. Recently, the locking plate has become a surgeon friendly implant in the treatment of complex fractures of the distal part of the tibia. Locking plates have the properties of both internal and external fixators and offer fixed angular stability through the head of locking screws. **AIM:** The purpose of this retrospective study was to assess the results of plate osteosynthesis using fixed-angle pre-contoured distal medial tibial locking plate (LCP) as a method of treating juxta-articular and intra-articular fractures of distal tibia. **MATERIALS AND METHODS:** This study was performed at the Department of Orthopaedic Surgery, Chettinad Hospital and Research Institute, IT Highway, Kelambakkam. Fractures in skeletally mature patients involving the distal metaphysis of the tibia requiring stability in sagittal or coronal plane with or without intra-articular extension were studied. From November 2012 to August 2013, 15 patients with distal tibial fractures were treated with a fixed-angle locking plate. There were 11 male and 4 female patients with an average age of 34.8 years (range, 20–67 years). The average follow-up was 12 months. The mechanism of injury included motor vehicle accidents (n=10), fall (n=3) and industrial accident (n=2). **RESULTS:** All fractures healed at an average time of 14 weeks (range, 10–18 weeks). Ankle final ranges of motion averaged 17° dorsiflexion (range, 0°-25°) and 34° plantar flexion (range, 20°-40°). All fractures healed with satisfactory alignment. There were 6 postoperative complications. The limitations in this study are its retrospective nature, small sample size and a short follow-up of one year. **CONCLUSION:** Our results show that the fixed angle locking plate provides a high degree of stability to very short segments of distal tibia, achieves high fracture union rates and with limited complications. Therefore, distal tibial LCP can be a reasonably suitable implant in the surgical treatment of fractures of distal tibia with or without intra-articular extension and with short metaphyseal segments.

KEYWORDS: fracture distal tibia, short metaphyseal fragments, pre-contoured LCP, mono-axial locking screws, ORIF, enhanced stability.

INTRODUCTION: The Operative treatment of fractures of the distal tibia with or without intra-articular extension poses a real challenge to the Orthopedic Surgeons because of the paucity of soft tissue, its subcutaneous location and poor vascularity. Also, precise control of reduction in metaphyseal and periarticular fractures of distal tibia is difficult. In distal tibial fractures, the fixation options include conventional open reduction & internal fixation (ORIF), minimally invasive plate osteosynthesis (MIPO), intramedullary nailing, combined internal fixation with external fixation and exclusive external fixation. Newer changes in intramedullary nail designs though have made distal metaphyseal fractures suitable to this type of fixation, difficulties with reduction, complex articular

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involvement, inadequate distal fixation etc. can limit its usage in some distal metaphyseal fractures. External fixation of such injuries can lead to complications such as pin tract infection, malunion and delayed union. In fractures with significant soft tissue injury, external fixation is often used as a temporary measure.

Recently, the trend towards the use of a locking plate for treatment of complex fractures of the distal part of the tibia is increasing. Locking plates have the biomechanical properties of internal and external fixators, with superior holding power because of fixed angular stability through the head of locking screws. Compared with a conventional plate, a locking plate imparts a higher degree of stability and provides better protection against loss of reduction. A monoaxial locking plate with the screw locked into the threaded hole at a predetermined angle permits multiple points of fixed-angle support, particularly in the short metaphyseal fragments. This retrospective study was undertaken to evaluate the functional outcome, healing rate and complications of distal third fractures of tibia stabilised after open reduction and stabilisation with pre-contoured distal medial tibial LCP from November 2012 to August 2013 in our Institute.

MATERIALS AND METHODS: This retrospective study was performed at the Department of Orthopaedic Surgery, Chettinad Hospital and Research Institute, IT Highway, Kelambakkam. Fractures in skeletally mature patients involving the distal metaphysis of the tibia requiring stability in sagittal or coronal plane with or without intra-articular extension were studied.

From November 2012 to August 2013, 15 patients were treated with a fixed-angle locking plate for fractures of distal third tibia. There were 4 female patients and 11 males with an average age of 34.8 years (range, 20–67 years). The average follow-up was 12 months. The mechanism of injury included motor vehicle accident (n=10), simple fall (n=2), fall from a height (n=1), and industrial accident (n=2). One patient had an associated fracture of shaft femur and another patient had a stable L1 compression fracture with contralateral calcaneal fracture both of which did not require surgical intervention.

All fractures involved the metaphyseal part of the distal tibia and in 7 cases, the fracture had an intra-articular extension into the ankle joint. According to the AO Classification, there were six 43A1, two 43A2, two 43B1, one 43B2, three 43C1 and one 43C2 fractures. One patient had a Type I open fracture as per the Gustilo and Anderson classification which was treated with emergent debridement, irrigation, tetanus prophylaxis, and intravenous antibiotics. Conventional open reduction internal fixation (ORIF) was done in 12 patients and percutaneous plate osteosynthesis (MIPPO) was done in 3 patients. The waiting time varied from 1 day to 12 days, from the day of injury until definitive internal fixation. The average time was 5.2 days. Bone grafting was done for 3 patients at the time of the initial procedure. Associated fibula fracture was fixed in 7 patients. (Refer table 1). Limb elevation was continued post-operatively. Suture removal was done between 12 to 14 days.

The patients were encouraged to perform ankle range-of-motion exercises from the 3rd post-op day, once surgical site pain reduces. Non-weight bearing walker mobilisation was started in the early post-op period. Patients were followed up clinico-radiologically at monthly intervals for the first 3 months and then at 6 weekly intervals thereafter upto one year to assess the progress of fracture union and complications, if any. From the 6th week, partial weight bearing on the operated leg was permitted.

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Radiological assessment was performed using antero-posterior and lateral views of distal tibia with ankle. Clinically, when the patient was able to bear full weight on the operated limb and radiologically when three of the four cortices was bridged, fracture union was ascertained. A lack of radiographic union by 24 weeks was termed as delayed union. A fracture that did not heal within a year was deemed as non-union. The incongruity of the articular surface of more than 2 mm or malalignment greater than 5° in any plane was termed as mal-union. Final functional outcomes were assessed at the end of one year using the Merchant & Detz scoring system. (Refer table 3) Time required to weight bear, time for bone union, limb alignment in the frontal and sagittal planes on AP and lateral radiographs, complications and their type etc. were considered, while measuring the outcome.

RESULTS: Pre-contoured distal tibial LCP was used in all the cases. Open reduction and internal fixation was used in 12 patients and MIPPO was used in 3 patients. 7 cases had an associated fibular fixation (6 cases of plating fibula and 1 case of TBW). Pre-existing contour of the tibial plate was not altered in any of the cases. We had one case of difficult skin closure on the fibular side. This patient later developed dehiscence of the fibular wound which healed with daily wound dressings. There was no case of exposure of implant in the postoperative period. Non-weight bearing walker mobilisation was started in the early post-op period. Partial weight bearing on the affected leg was permitted from the 6th week. Full weight bearing was allowed after radiological evidence of union of fracture.

The average time to union for all fractures was 14 weeks (range, 10–18 weeks). The final range of motion averaged 17° (range, 0°-25°) ankle dorsiflexion and 34° (range, 20°-40°) ankle plantar flexion. Postoperative x-rays did not show any malalignment of fractures. Union of all the fractures was within acceptable limits of alignment (varus or valgus angulations <5°, internal or external rotation <5°, limb length discrepancy <1 cm). There were no cases of delayed union or non-union in our series. There were 6 postoperative complications (table-2). Three patients reported occasional pain over the medial malleolus. One superficial infection occurred in the early postoperative period which resolved with antibiotics. No deep infection was noted. One patient with AO type A2 fracture had delay in wound healing of the fibular skin incision, which then resolved with local wound care. One patient with AO type C2 fracture had a full thickness skin necrosis adjoining the anterior incision around medial malleolus. This needed a wound debridement and a fascio-cutaneous rotation flap. There was no loss of fixation in any of the cases. The Merchant & Detz scoring system was used to assess the functional outcome at the. We had one excellent result, ten good results and four fair results. There was no poor result in our series. (Table 3)

Age	20 - 67 (mean 34.8)
Male/Female	11/4
AO classification A/B/C	8/3/4
Road Traffic Accident	10
Fall	3
Industrial accident	2
Open / MIPPO	12/3
Fibular fixation	7 (Plating - 6, TBW - 1)
Primary bone grafting	3

Table 1: Demographic profile of the Patients

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DISCUSSION: Currently, Plate osteosynthesis with LCP has become popular in the treatment armamentarium of periarticular fractures of distal tibia. A monoaxial locking plate with fixed angle locking screws provided stable fixation of the distal fragment. A monoaxial locking plate system permits multiple locking screws in the distal fragment with better pullout strength and angular stability. The locking plate offers substantial benefits such as increased stability, decreased need for adjunctive implants thereby enabling to achieve early functional recovery. Although percutaneous plating (MIPPO) has a definite biologic advantage over classic open approach, especially when there is a soft tissue compromise, the long conventional incision was used in 12 of the 15 patients studied. MIPPO was done only in 3 cases. Intramedullary nailing, though biological, suffers from a limitation of inadequate distal fixation in the short distal fragment, more so, when there is bone comminution.

All the fractures in our study united within six months. There were no cases of malunion or non-union. Our healing rates were much superior to other similar studies reported using ORIF with LCP. This could be explained by the fact that 8 of the 15 fractures (53.3%) in our study were AO type A fractures which are extra-articular, simple fractures and only 1 of the 15 was an open fracture. 7 of the 15 patients underwent simultaneous fixation of fibula (46.6%) (6 cases of plating fibula and 1 case of tension band wiring). Fixation of fibular fracture along with that of tibia not only facilitated reduction of the distal tibial fracture but also increased the stability of the construct. In our series, no case of postoperative loss of fixation was seen. Three of the 15 patients (20%) underwent primary bone grafting of the tibia.

Because the distal tibia is covered by scant soft tissue, precise anatomic contouring of a locking plate is required to ensure a good match between the plate and the distal part of the tibia. This in turn would help to reduce prominence of implant under the skin. Pain over the medial malleolus was observed in three patients (20%), which were attributed to the plate-bone mismatch. Intra-operative use of an image intensifier would help to avoid prominence of the anterior part of the plate on the medial aspect of the ankle, thereby reducing soft tissue impingement.

R. K. Gupta et al. in their study reported skin irritation in the distal scar and pain over the medial malleolus in 81% patients where the 4.5-mm LCP was used and 60% where the metaphyseal LCP was used, both attributed to bulkiness of the implant. Gao et al. in their study observed that only 19% of patients had local discomfort over the medial malleolus comparable to what we have observed in our study (Reference no: 13). This could be explained by the use of low profile plates in our study.

We had one case of superficial wound infection which settled with daily wound dressing and appropriate antibiotics. There was no deep infection in our study. Rakesh k. Gupta et al. in their study of 79 fractures treated with LCP, reported only one case of superficial wound infection and no case of deep infection. Using an aseptic surgical technique, giving due respect to the soft tissues and use of a 1st generation cephalosporin (one pre-op loading dose of IV antibiotic half-an-hour before incision, followed by 4 post-op doses) for antibiotic prophylaxis go a long way in preventing surgical site infection (SSI).

One patient had full thickness skin necrosis around medial malleolus, along the tibial skin incision which required a fascio-cutaneous flap cover. This patient, a 25 year old lady with AO type 43C2 fracture had a simultaneous fixation of both tibial and fibular fractures. She underwent a fascio-cutaneous flap cover by the plastic surgeon. The flap survived well and her fracture united uneventfully in four months' time. Meticulous handling of soft tissues during surgery and maintaining

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a skin bridge of at least 7cms between tibial and fibular skin incisions can help prevent such a complication. The timing of surgery plays a key in determining wound related problems. As distal tibial fractures generally produce significant swelling of leg and ankle, pre-op limb elevation and waiting for the “wrinkle sign” to appear before embarking on surgery play a vital role in prevention of such problems.

The strength of this study is that the data analysed pertains only to fractures of distal tibia with relatively short distal segments. The retrospective nature, small sample size and a short follow-up are the limitations of this study. More than half of the fractures in the current series were AO type A fractures which are extra-articular fractures and only 7 of the 15 patients (46.6%) had fractures with extension into ankle joint. Therefore, although fracture union could be achieved in all the patients, a longer follow-up period is required to assess the incidence of post-traumatic arthritis, if any, develops in these patients later.

Malunion	Nil
Non-union	Nil
Wound infection	
Superficial	1
Deep	Nil
Wound dehiscence	2
Pain over medial malleolus	3
Table 2: Complications	

(90-100 points) Excellent	1
(80-89 points) Good	10
(70-79 points) Fair	4
(< 70 points) Poor	Nil
Table 3: Functional outcome (Merchant and Detz scoring system)	

CONCLUSION: We conclude that open reduction and internal fixation with pre-contoured fixed angle distal tibial locking plate for fractures of distal tibia, with short metaphyseal segments, gives excellent results in terms of fracture union, restoring ankle ROM and early return to pre-injury status and the results are reproducible. Timing of surgery and soft tissue handling are crucial factors in determining the outcome.

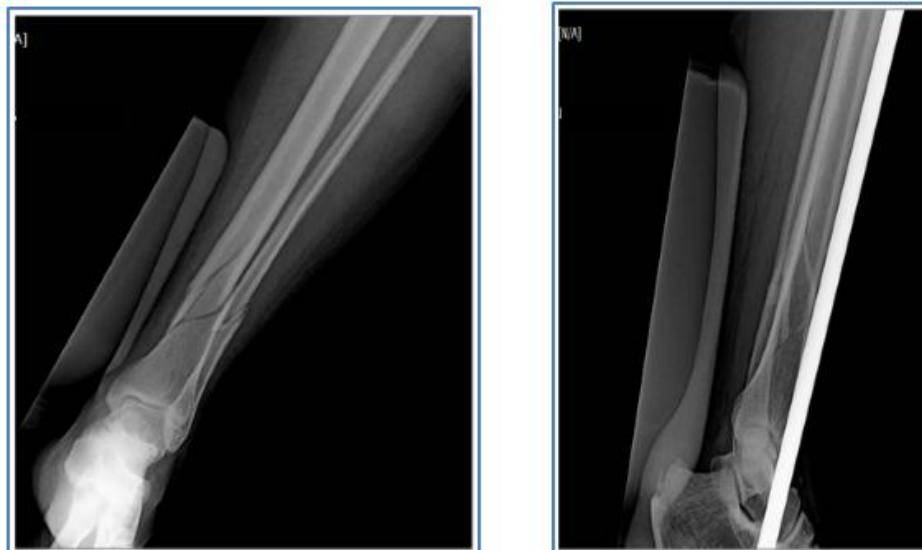
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42 YRS. FEMALE



PRE-OP: AP & LATERAL

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POST-OP: 14 MONTHS



14 MONTHS CLINICAL FOLLOW UP

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35 YRS FEMALE, AO 43B2



PRE- OP



POST- OP



Full Thickness Skin Necrosis



After Flap Cover

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AO 43 C2 – POST-OP X-RAY

AUTHORS:

1. Chander S. G.
2. Kanagasathy K.
3. Balaji Govindarajan
4. M. Narayana Reddy

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Orthopaedics, Chettinad Hospital & Research Institute.
2. Assistant Professor, Department of Orthopaedics, Chettinad Hospital & Research Institute.
3. Senior Resident, Department of Orthopaedics, Chettinad Hospital & Research Institute.

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4. Professor & HOD, Department of Orthopaedics, Chettinad Hospital & Research Institute.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Chander S. G,
12/10, Singaperumal Koil Street,
Triplicane, Chennai-600005.
E-mail: gcshrinithi@yahoo.com

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