Outcome analysis of management of tibial pilon fracture by medial locking compression plating

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Abstract

Introduction: Fractures of the distal tibia can be challenging to treat because of limited soft tissue, the subcutaneous location and poor vascularity. Fractures of distal tibia remain a controversial subject despite advances in both nonoperative and operative care. The goal in expect care is to realign the fracture, realign limb length and early functional recovery. The aim of our study is to analyze the functional outcome of distal tibial fractures treated by Medial Distal Tibial Locking Compression Plate (LCP).

Materials and Methods: This prospective study conducted over a period of 4 yrs from May 2015 to November 2018 after ethical committee approval. Patients in age group of 18-65 yrs presenting with closed distal tibial fractures of Ruedi and Allgower type – I, II, III were included in this study. Compound fractures and Age <18 & >65 were excluded. Patients with associated calcaneal and talus fractures were also excluded. Functional results were analysed with Iowa ankle evaluation score and radiological reduction is analysed with Teeny & Wiss scoring criteria.

Results: The total number of patients included in this study was 30 with age range between 20-64 with a mean age of 32.8yrs. M:F 12:18. RTA being the most common mode of injury among them. Based of Ruedi Allgower types 8 belonged to Type A while 10, 7, 5 belongs to Types C1,C2,C3 respectively. 16 of them had fibular fracture at same level while 8 had fibular fracture at different level while 6 had intact fibula. We had a minimum follow up of 1 yr and maximum follow up of 4 yrs with mean follow up of 2.8 yrs. Union was achieved in all cases between 12-16 weeks. The mean duration from hospital admission to definitive surgery was around 10-14days. The mean functional ankle scores were 80.5with a maximum of 94 and minimum of 74. Anatomic reduction was achieved in about 22 cases with good alignment.

Conclusion: Medial Tibial locking compression plating can be considered as a reliable modality of management of distal tibial fractures and it has to be done either within 24 hrs of the injury before the edema sets in or a delay of 8 to 12 days for the edema to settle down and the wrinkle sign appears. Respect the soft tissues, do not operate too early or through compromised skin, instead wait till the soft tissues is amenable for surgery. Restoration of the articular surface and reestablishing its relationship to the tibial shaft is the primary goal of treatment. Good functional result depends on reasonable anatomic reduction of the articular surface either by direct or indirect methods.

Keywords: medial distal tibia plating, LCP, iowa ankle evaluation score, teeny & wiss scoring

Introduction

Fractures of the distal tibia can be challenging to treat because of limited soft tissue, the subcutaneous location and poor vascularity. Fractures of distal tibia remain a controversial subject despite advances in both non-operative and operative care. The goal in expert care is to realign the fracture, realign limb length and early functional recovery. Fractures of distal tibia remains one of the most challenging for treatment because of high complication rates both from initial injury and also from treatment. All these fractures are severe injuries. They are increased in frequency because of higher incidences of Road Traffic Accidents. Accounts to 1% of all lower extremity fractures, 10% of tibial fractures and bilateral in 0-8% and compartment syndrome in 0-5%.

The mechanism of injury is axial loading due to talus hitting hard the lower end of the tibia. The axial loading on the distal tibia determines the articular surface injury, metaphyseal comminution, joint impaction and severe associated soft tissue injuries. Although the mechanism of injury may be complex, the predominant force is vertical compression. The location of the articular portion of the fracture is determined by the position of the foot at the moment of impact.
Fractures involving the distal third of tibia involve the metaphyseal flare which poses the difficulty of decreased implant contact leading to less stability and increased malalignment. Even minor malalignment in this region causes gross mechanical alteration of the ankle thereby leading to increased pain and functional disability. Surgical fixation of distal tibial fractures can be difficult, and require careful preoperative planning. Fracture pattern, soft tissue injury, and bone quality critically influence the selection of fixation technique. Several techniques have emerged – conservative, hybrid external fixation, external fixation with limited internal fixation, percutaneous plate osteosynthesis and intramedullary nailing.

Several minimally invasive plate osteosynthesis techniques have been developed, with union rates ranging between 80% and 100%. These techniques aim to reduce surgical trauma and to maintain a more biological favourable environment for fracture healing. Nevertheless, complications such as angular deformities greater than 7°, hardware failure and non-unions have been reported. A new advance in this field is represented by the “locked internal external fixators”. These devices consist of plate and screw systems where the screws are locked in the plate at a fixed angle. Screw locking 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.

The system works as flexible elastic fixation that putatively 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 the plate. As the plate is not compressed against the bone the periosteal supply is not disturbed which favours bone healing.

Despite with advances in identification, understanding and treatment of soft tissue injury and with the liberal use of Computed Tomography scanning, advances in implant design which includes locking plate technology, still the management of these challenging fractures remains elusive. Hence aim of this study is to analyse the functional and radiological results of management of distal tibial fractures with medial tibial locking compression plates (LCP).

**Materials & Methods**
This prospective study conducted over a period of 4 yrs from May 2015 to November 2018 after ethical committee approval. Patients in age group of 18-65 yrs presenting with closed distal tibial fractures of Ruedi and Allgower type – I, II, III were included in this study. Compound fractures and Age <18 & >65 were excluded. Patients with associated calcaneal and talar fractures were also excluded. Functional results were analysed with Iowa ankle evaluation score and radiological reduction is analysed with Teeny & Wiss scoring criteria.

**Surgical procedure**
Under regional anaesthesia in supine position on a radiolucent table, a small soft supportive bump or towel roll is placed beneath the ipsilateral buttock, flank and shoulder region to minimize the tendency to externally rotate.

**Fibula**
Fibular was exposed by posterolateral approach as shown in Figure 1. Reduction and fixation is performed using the lateral approach to the fibula, with 1/3 rd tubular plate and 3.5 mm cortical screws.

**Tibia**
We used Modified Anteromedial approach as shown in Figure 1. Skin incision is approximately 1 cm lateral to tibial crest and follows the course of tibialis anterior tendon. At the level of ankle joint, the skin incision continues distally and medially, ending at the distal tip of medial malleolus. The plane of dissection is medial to anterior tibial tendon. Fracture fragments identified, reduced and fixed with temporary k – wires and then definitive fixation with 3.5 mm medial distal LCP with locking screws 20.

For AO type A fractures we used the technique of MIPPO. Here the incision was just proximal to the medial malleolus either transverse or longitudinal. The fracture was reduced indirectly and the plate was inserted through the incision. Through stab incision screws were inserted in the proximal fragment. For AO type C fractures we did open reduction of the fracture fragments and then fixed with LCP.

**Post Op protocol**
- Drain removal after 48 hrs.
- Suture removal on 12 post op day.
- Radiological examination once in every 6 weeks
- After removal of sutures ankle mobilization was started with non-weight bearing walking with walker.
- Once radiological union started partial to full weight bearing was allowed.

All cases were assessed using the IOWA ankle score and Teeny Wiss radiological scoring.
Results
The total number of patients included in this study was 30 with age range between 20-64 with a mean age of 32.8yrs. M:F 12:18. RTA being the most common mode of injury among them. Based on Ruedi Allgower types 8 belonged to Type A while 10, 7, 5 belongs to Types C1, C2, C3 respectively. 16 of them had fibular fracture at same level while 8 had fibular fracture at different level while 6 had intact fibula. We had a minimum follow up of 1 yr and maximum follow up of 4 yrs with mean follow up of 2.8 yrs. Union was achieved in all cases between 12-16 weeks as shown in Figure 2. The mean duration from hospital admission to definitive surgery was around 10-14days.

Functional Score
A variety of rating systems were proposed for subjective and objective components. We have used modified Teeny and Wiss Score for radiological evaluation of ankle and IOWA scoring for functional analysis. The mean functional ankle scores were 80.5with a maximum of 94 and minimum of 74. Anatomic reduction was achieved in about 22 cases with good alignment.

Table 1: Showing the scoring, excellent and good fair

<table>
<thead>
<tr>
<th>Scoring</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>9</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Type C1</td>
<td>5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Type C2</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Type C3</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Teeny wiss radiological scoring
In our study we were able to achieve anatomic reduction in 72% (22cases) of the patients. Good in 5, Fair in 2 and Poor in 1 case respectively.

Table 2: Showing the reduction AP to C3

<table>
<thead>
<tr>
<th>Reduction</th>
<th>AO Type A</th>
<th>Type C 1</th>
<th>Type C 2</th>
<th>Type C 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anatomic</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Good</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fair</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Poor</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Complication
In our study we had superficial infection in 3 cases and one case of deep infection. All superficial infection settled with higher antibiotics and with wound wash. The case of deep infection required implant removal and was treated with hybrid ex-fix.

Discussion
Distal tibial fractures result from a range of low to high energy axial loading and are commonly associated with comminution of both the metaphysis and the distal fibula. This relative rare injury (<10% of lower extremity fractures) occur in adult owing to fall from height or from road traffic crash. The ideal or optimal treatment for these fractures remains controversial. Fractures of distal tibia most often associated with significant soft tissue injuries. The treatment of distal tibial fractures can be challenging because of its subcutaneous location, poor vascularity and limited soft tissue. The key point is treatment of this injury is to recognize the importance of these soft tissue compromises. Definitive fixation is only advisable and done only when the soft tissue
allows for surgery or when the wrinkle sign is evident. Minimally invasive plating techniques reduce the iatrogenic soft tissue injury and damage to bone vascularity, and also preserve the osteogenic fracture hematoma.

The key principles in the management of these fractures — Restoration of the length and axis of the tibia and fibula; the reconstruction of the distal end of tibia; the filling of the defect resulting from impaction and the support of the medial side of tibia, by plating to prevent the varus deformity.

In our study we used a single-stage fixation of all distal tibial fractures. We used medial distal tibial locking compression plate for all cases. This plate is a low profile plate of 3.5 mm system. The Medial distal tibial plate is a precontoured plate to that of the distal tibia and thus allows placement of the plate without disruption of fractures fragments. The thread holes in the plate locks to that of the screw head and minimize plate-bone interface and maintain the vascularity at the fracture site.

Among 30 patients, all AO type A (10 cases) fractures were managed with MIPPO technique. AO type C3 fractures were managed with open reduction of the articular surface and fixed with locking compression plate. AO type C1 and C2 fractures were managed using MIPPO technique and the fractures was transfixed through the plate.

Our study included a total of 30 patients. The peak incidence in our study was among the age group between 40-50 years. In our study we had excellent union and functional outcome in about 27 cases (90%) and 3 cases (10%) of fair outcome based on IOWA scores. As per TEENY WISS SCORE we had good anatomic rating in about 22 cases (72%), good rating in about 5 cases (18%), fair in 2 cases (8%) and one case (2%) of poor rating.

Mast et al. recommended primary definitive internal fixation if the patient was presented early within 8 to 12 hours following injury. They advocated a delay in the definitive procedure for about 7 to 10 days for soft tissue to heal, if the patient presented late. In our study the average duration of delay in the definitive treatment was about 10 to 14 days27.

Patterson and Cole et al. reported an impressive 0% infection rate following fixation after an average of 24 days, however this study is limited by its relatively small sample size. In our study we had a delay of about 10 to 14 days before going for definitive stabilization.

Barei et al. demonstrated that distal tibial fractures with intact fibula, on the whole was considered as less severe injury than those with fractured fibula. An intact fibula was identified as less severely injured than C type fractures.

The first principle of management by Ruedi and Allgower was restoration of fibular length which remains vital to the outcome. Plating was done in fracture fibula had gross displacement which required fixation with 1/3rd tubular plate. Plating was done in fracture fibula with comminution. The rest of the cases were not fixed as most of the fractures were undisplaced stable fractures or it was fractured at different levels. All fibula fractures healed within 3 months without any gross complications.

Helfet et al. in their study had a superficial infection rate of 3% and deep infection of 6% in their series of 32 fractures treated with locking compression plate. In our study we had 3 cases (10%) of superficial infection and 2 cases (8%) of deep infection, which was comparable to the above study.

Philip et al. and Mark Jackson et al. in their study of complication of definitive open reduction and internal fixation of distal tibial fractures, they had good functional result in 73.7% cases and 5% of deep infection rate in a follow up of 30.4 months. In our study we had 72% of good functional outcome and 8% of deep infection rate, which was acceptable when compared to the above study.

Pierre Joveniaux et al. and Xavier Ohi et al. in their study of distal tibia fracture: management and complication, they had a functional score of 76% in their series. Their result had 20 cases of excellent, 15 cases of good, 9 cases of fair and 6 cases of poor in their series of 30 cases. In our study we had nearly 22 cases of excellent outcome, 5 cases of good, 2 cases of fair and one case of poor outcome among the 30 cases35.

Mario Ronga MD et al. and Nicola Maffulli MD et al. in their study of minimally invasive locked plating of distal tibial fractures, they had the following outcomes of the 21 cases they achieved union in 20 cases and one case went in for nonunion. They had 3 cases of angular deformities all less than 7° and no patient had a leg-length discrepancy. Compared to their study, in our study we used MIPPO in about 14 cases, in which all cases went in for union in about 10 to 14 weeks with no case of malunion or nonunion26.

Rakesh Gupta et al. and Rajesh Kumar Rohilla et al. in their study of locking plate fixation in distal tibial fractures — series of 79 patients, had reported about 88% of healing without malunion, 2.5% of malunion and 3.7% of nonunion. They used both MIPPO and ORIF for fixing these fractures. They found good and early union rate in the MIPPO group. In our study also we had good and early union in the MIPPO group and also we had no case of malunion or non-union.

Pugh and colleague evaluated 60 patients, 25 of whom were treated with external fixators. They noted that they had more number of malunion in the external fixator group compared to that of internal fixation. They met most of their complication in the external fixator group. In our study also we had good functional outcome in internal fixation group38. The average follow up period our study was 9.4 months (range from 6 to 20 months). In type III fractures patients may develop late secondary arthrosis, but it requires a longer follow up. In our series, the results of the patients who had long follow up period of more than 22 months had good clinical scores despite some early mild arthritic changes in type C severe comminuted fractures.

Anatomic realignment of fibula indirectly reduces the talus beneath the anatomic axis of tibia. Restoration of fibular length, alignment and 78 rotation has the substantial impact on the indirect realignment of anterolateral and posterolateral tibial plafond from their attachment to the anterior and posterior tibiofibular syndesmotic ligaments. Hence fibula fixation is advocated wherever possible.

The incidence of head injury or spinal cord injury was less in our series compared to other studies. 15% of our cases had associated other bony injuries like fractures of clavicle and distal radius. Hence the outcome of surgically treated distal tibial fractures depends on the associated injury to and the management of, the soft tissues surrounding the injury and accuracy of the articular reduction. A correlation exists between the severity of the fracture, overall outcome and the development of secondary degenerative arthritis.

Conclusion

Medial Tibial locking compression plating can be considered as a reliable modality of management of distal tibial fractures and it has to be done either within 24 hrs of the injury before the edema sets in or a delay of 8 to 12 days for the edema to settle down and the wrinkle sign appears. Respect the soft
tissues, do not operate too early or through compromised skin, instead wait till the soft tissues are amenable for surgery. Restoration of the articular surface and reestablishing its relationship to the tibial shaft is the primary goal of treatment. Good functional result depends on reasonable anatomic reduction of the articular surface either by direct or indirect methods. This study is the authentic work of the authors. No financial benefits were received from any commercial party for this study.

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References