Appraisal of Clinical and Radiological Outcome of Management of Distal Tibia Fractures With Distal Tibia Locking Plate (DTLP)

Dr. Simranjit Singh*, Dr. Rajesh Kapila**, Dr. Kamal Kumar Arora***, Dr. Rakesh Sharma****, Dr. Priti Chaudhary*****

Corresponding author:
Dr. Kamal Kumar Arora
163-B, Bazar No.7
Opp. S.K. Electronics
Near Neem Wala Chowk,
Ferozepur Cantt
Mob: 98559-52964
Email: kka1967@gmail.com

*Senior Resident, Department of Orthopaedics, Govt. Medical College, Amritsar
**Professor, Department of Orthopaedics, Govt. Medical College, Amritsar
***Assistant Professor, Department of Orthopaedics, Govt. Medical College, Amritsar
****Professor, Department of Orthopaedics, Govt. Medical College, Amritsar
*****Professor, Department of Anatomy, G.G.S. Medical College, Faridkot

Abstract: Distal tibial fracture is one of the commonest fracture following accidents in over 15% of total fracture cases. The triumph key in managing these niggling fractures is to proficiently preserve, reconstruct the soft tissues, acceptable reduction & early mobilization. AO/OTA classification system is used now a days to classify these fractures. The concept of “biological osteosynthesis”, a terminology introduced to designate a new & novel type of osteosynthesis leading to a sufficiently stable fixation of bone fragments allowing early mobilization, and that too without major disturbance of the vascular supply. The advantages of distal tibial locking plates (DTLP) apply most directly to highly comminuted fractures, unstable metaphyseal segments, and osteoporotic fractures.

Key Words: DTLP, biological osteosynthesis, distal tibial fractures.

Date of Submission: 17-04-2018
Date of acceptance: 05-05-2018

I. Introduction
Fracture of distal tibia is one of the commonest fracture following accidents in over 15% of total fracture cases. As for the tibia, its subcutaneous nature and be short of adequate musculature medially makes it more vulnerable to fracture and consequential bone trouncing. The triumph key in managing these niggling fractures is to proficiently preserve, reconstruct the soft tissues, acceptable reduction & early mobilization. These fractures are making happen either by direct vehemence or indirect trauma.

Sir John Charnley in 1961 stated: “we have still a long way to go before the best method of treatment of the shaft of tibia can be stated with finality”. Shaggish rate of union is usually as a result of severity of fracture, meagre blood supply to one fragment and sometime distraction of bone fragments; sporadic limitation of joint movement in knee, ankle and foot, usually caused by allied joint soft tissue and vascular injury.

Ruedi and Allgower's classification was the first in widespread use accountabilty. This classified axial loading fractures of distal tibia into three types, based on the degree of comminution of the articular surface.1

Of late this has largely been supplemented by AO/OTA classification system.2

II. AO/OTA CLASSIFICATION

It groups distal tibia fractures as 43.
Type A fractures are extraarticular distal tibial fractures, subdivided into A1, A2, and A3 groups, based on the amount of metaphyseal comminution.
Type B fractures are partial articular fractures & a portion of the articular surface remains in permanence with the shaft; these are subdivided into B1, B2, and B3, depending upon the amount of articular impaction and comminution.
Type C fractures are complete metaphyseal fractures with articular involvement; these are subdivided into C1, C2, and C3, based on the extent of metaphyseal and articular comminution.

In present study, AO classification had been followed. A choice of management options include: close reduction & pop cast application, external fixation, intramedullary nailing, open reduction and internal fixation. Conservative management nowadays is by and large reserved for low-energy closed, stable, isolated, minimally displaced fractures.

Operative treatment is indicated for most high-energy displaced comminuted tibial fractures as these are unstable, and associated with varying degrees of soft-tissue trauma. It allows early movement, provides soft-tissue access, and avoids complications associated with immobilization with pop cast.

The complications with other methods have innovated the concept of "biological osteosynthesis", a terminology introduced to designate a new & novel type of osteosynthesis leading to a sufficiently stable fixation of bone fragments allowing early mobilization, and that too without major disturbance of the vascular supply. Locking minimizes the compressive forces exerted by the implant on the bone. Precise anatomical contouring of a implant is no longer a pre requisite. This prevents the loss of primary reduction of fracture fragments caused by inadequate contouring of a plate.

The advantages of locking plates apply most directly to highly comminuted fractures, unstable metaphyseal segments, and osteoporotic fractures. These plates act as "internal fixators". Hybrid techniques that combine the benefits of compression plate fixation with the biological and biomechanical advantages of locking plates are the most likely end result of current locking plate applications.

The main foundations of using a locking plate embrace four classic principles as documented below:

1. The compression principle,
2. The neutralization principle,
3. The bridging principle
4. The combination principle,

The bridging principle, is classically represented by the concept of minimally invasive percutaneous plate fixation (MIPPO technique), whereby the angular-stable plate is used as an internal splint that bridges the comminuted fracture. The combination principle refers to a biomechanical mixture of compression and bridging with only one implant, indicated for fixation of fractures with a simple pattern (e.g. an intra-articular split) at one level and comminution (e.g., metaphyseal-diaphyseal comminution) at a different level.

Proponents of medial plating cite the technical ease of the approach, the ability to perform a minimally invasive procedure, and decreased local soft tissue disruption at the fracture site as the primary advantages.

III. Aim and Objectives

To appraise clinical and radiological outcome of management of distal tibial fractures using distal tibial locking plate (DTLP).

IV. Material and Methods

This was a prospective study of 25 cases of fractures of distal tibia, admitted & managed in tertiary care hospital of Punjab.

V. Inclusion Criteria

Fracture distal tibia (closed,open type A and type B ) extra & intra articular in adults
Exclusion criteria:- Previous or existing infection, gross comminution of the involved bone, compound grade III fractures.

Fractures were classified according to AO classification and patients assessed. Preoperative x-rays were done in both planes. Under spinal/epidural anaesthesia, fracture site was exposed by standard medial approach, in metaphyseal fractures without intraarticular extension or comminution, MIPPO technique was followed. In case of intraarticular fractures, accurate reduction was confirmed and provisional fixation was done with K wires or screws before proceeding to final plate fixation.

In MIPPO technique, incision was made obliquely at the tip of medial malleolus and extended proximally with care taken to protect the great saphenous vein. Extraperiosteal tunnel for the plate was created & after plate insertion, the proximal central position of the same on the tibial shaft was checked followed by insertion of non locking cortical screws and locking screws. All the non locking screws were inserted first to achieve reduction and thereafter locking screws were inserted with a minimum of four screws in each fracture fragment. This was followed by irrigation with normal saline and wound closure in layers over closed suction drain. Post operative check X-rays were done. Ankle mobilization started as early as possible. Patient followed up and assessed clinically and radiologically till the union occurred. The outcome of distal tibial fractures
management with locking plates was assessed in terms of time to bony union, range of Ankle movement, Malunion, Infection, secondary procedures performed (if any).

VI. Observations
The present study enrolled 25 patients with fracture of distal end tibia with an average age 38.04 years. It was observed that comminuted fractures of the distal end tibia were more common (60%) in young and middle age groups (20-40 years). We observed that in our series 76% were males and 24% were females (male: female ratio 3.16:1).

Road traffic accident was most common cause (64%) of injury.

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>DISTRIBUTION OF SUBJECTS ACCORDING TO MODE OF INJURY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of Injury</td>
<td>No. of Patients</td>
</tr>
<tr>
<td>RTA</td>
<td>16</td>
</tr>
<tr>
<td>Fall</td>
<td>9</td>
</tr>
</tbody>
</table>

64% patients had isolated distal tibial fracture, however 36% patients had associated injuries, out of these 28% patients had trivial fall, 12% cases were with head injury, 08% cases with chest injury, 08% with fracture patella and 08% with fracture radius.

TABLE IV
DISTRIBUTION OF SUBJECTS ACCORDING TO ASSOCIATED INJURIES

<table>
<thead>
<tr>
<th>Associated Injury</th>
<th>No. of Patients</th>
<th>Percentage</th>
</tr>
</thead>
</table>

DOI: 10.9790/0853-1705011420  www.iosrjournals.org
Fractures were graded in accordance to AO/OTA Classification (80% were grade A, 12% were grade B, and the remaining 08% were grade C).

### TABLE 5
**DISTRIBUTION OF SUBJECTS ACCORDING TO TYPE OF FRACTURE - AO CLASSIFICATION**

<table>
<thead>
<tr>
<th>Type of Fracture</th>
<th>No. of Patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extra Articular (Type A)</td>
<td>20</td>
<td>80%</td>
</tr>
<tr>
<td>Partial Articular (Type B)</td>
<td>03</td>
<td>12%</td>
</tr>
<tr>
<td>Complete Articular (Type C)</td>
<td>02</td>
<td>08%</td>
</tr>
</tbody>
</table>

- 84% patients had closed fractures, while 16% had open fractures.

### TABLE 6
**DISTRIBUTION OF SUBJECTS ACCORDING TO TYPE OF FRACTURE (OPEN/CLOSED)**

<table>
<thead>
<tr>
<th>Type of Fracture</th>
<th>No. of Patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Type 1</td>
<td>04</td>
<td>16%</td>
</tr>
<tr>
<td>Type 2</td>
<td>03</td>
<td>16%</td>
</tr>
<tr>
<td>Type 2</td>
<td>01</td>
<td>04%</td>
</tr>
<tr>
<td>Closed</td>
<td>21</td>
<td>84%</td>
</tr>
</tbody>
</table>

**Immediate early and late postoperative complications:**

- Early complications (within first two weeks) were in form of fever in 3, superficial infections in 4, superficial skin necrosis in 3 cases.
- In late complications (after two weeks postoperatively to till union occurred), 12% patients had persistent pain, 4% had mal-union, 08% had deep infection and subsequent implant removal.

### TABLE 7
**DISTRIBUTION OF PATIENTS ACCORDING TO POST OPERATIVE COMPLICATIONS**

<table>
<thead>
<tr>
<th>Complications</th>
<th>No. of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early postoperative complications:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fever</td>
<td>03</td>
<td>12.00%</td>
</tr>
<tr>
<td>Skin Necrosis</td>
<td>04</td>
<td>16.00%</td>
</tr>
<tr>
<td>Superficial Infection</td>
<td>03</td>
<td>12.00%</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>40.00%</td>
</tr>
<tr>
<td>Late postoperative complications:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistent pain</td>
<td>3</td>
<td>12.00%</td>
</tr>
<tr>
<td>Malunion/ shortening</td>
<td>1</td>
<td>04.00%</td>
</tr>
<tr>
<td>Deep infection/implant removal</td>
<td>2</td>
<td>08.00%</td>
</tr>
</tbody>
</table>

92% cases united primarily after fixation; of these 32% fractures united by 16 week, 48% by 20 weeks &12% by 24 weeks.

- Average time of union was 19.13 weeks.
- We observed fracture non union in 04% patients at 6 month follow up.

### TABLE 8
**DISTRIBUTION OF SUBJECTS ACCORDING TO TIME TO BONY UNION (RADIOLOGICAL)**

<table>
<thead>
<tr>
<th>Time</th>
<th>No. of Patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>By 16 weeks</td>
<td>8</td>
<td>32%</td>
</tr>
<tr>
<td>By 20 weeks</td>
<td>13</td>
<td>52%</td>
</tr>
<tr>
<td>By 24 weeks</td>
<td>3</td>
<td>12%</td>
</tr>
</tbody>
</table>

**VII. Discussion**

Treatment of distal tibial fractures has always posed a confront because of associated soft tissue injury and comminution. The main aim of managing these fractures is to achieve bony union in proper alignment and good functional outcome.

The study included 25 patients with age ranging from 19 to 70 years with a mean age of 38.04 years with a preponderance of comminuted fractures of distal end tibia in young and middle age groups (20-40 years). In our series, 76% were males and 24% were females (male: female: 3.2:1).
In a prospective study Hazarika S et al reported their experience in treatment of distal tibia fractures in 20 patients with a mean age of 44.7 years (range 19-69 years), managed with locking plates. There were 80% males and 20% females (male: female: 4:1)\textsuperscript{11}

In a prospective study Mushtaq A. et al reviewed 21 patients with distal tibia fracture treated with LCP internal fixation. 66.6% were males and 33.3% female patients (male: female: 2:1) with a mean age of 51 years were included.\textsuperscript{12}

A prospective study on 62 patients by Leung FK et al who were treated for distal tibia fractures who were treated with locking compression plates from August 2002 to August 2007 and observed that patient’s age ranged from 21-87 years with a mean age of 44 years old.\textsuperscript{13}

Hence, present study is in accordance with the earlier studies as stated above, as this is the age group indulging in more outdoor activities, thus more prone to injury.

16 out of 25 patients majority of patients (64%) suffered such fracture after high velocity road traffic accidents. Other causes were fall in 7 cases (28%), and two cases were result of assault. In 4 of the female patients, the fracture sustained was a result of fall and the fall were trivial. Poor bone stock (osteoporotic) in trivial fall cases was evident on the preoperative radiographs.

A retrospective study on 79 patients by Gupta RK et al., with distal tibia fractures observed that 68 (86.08%) patients were injured after road traffic accidents and 11 (13.92%) patients had a fall.\textsuperscript{14}

A prospective study on 62 subjects by Leung FK et al. from August 2002 to August 2007 observed that nine patients sustained RTA, four patient’s sustained injury in fall while the rest of the patients sustained injury as a result of twist.\textsuperscript{13}

In a randomized, Vallier HA et al did a prospective comparison of plate versus intramedullary nail fixation for distal tibia shaft fracture by assessing complications and secondary procedure in 104 patients. They observed that 36 (34.61%) patients sustained injury in RTA, 38 (36.53%) patients sustained it in fall while 17 (16.34%) patients sustained crush injuries.\textsuperscript{15}

Hence distal tibia fracture most commonly occurs after high energy trauma especially motor vehicular accidents; while in an osteoporotic bone, these fractures can result even after trivial injury.

In this study, 9 (36%) patients had associated injuries, however 16 (64%) patients had isolated distal tibial fracture (these include 7 patients who had such fracture following a trivial fall). There were 12% cases with head injury, 04% cases with chest injury, 08% with fracture patella, 04% patients had nasal bone fracture, 04% cases with avulsion over opposite leg, and 04% patients with ulna fracture. Hence fracture of distal tibia should be thoroughly assessed as such fractures are often associated with multiple injuries due to association with high velocity trauma.

Fractures were graded in accordance to the (AO/OTA Classification). It was observed that 64% out of 25 fractures were grade A, 20% were grade B, and the remaining 16% were grade C. Amongst grade A fractures, Grade A3 was the commonest with 7 (43.8%) fractures, 3 (18%) were grade A1, 6 (37.50%) were grade A2 fractures. More than half of the fractures were comminuted type (A3 B3 C3).

In a retrospective study Leung FK et al recruited 62 subjects from August 2002 to August 2007 at mean age of 44 years old (range, 21-87 years old). According to AO classification, there were 8 cases of type A1, 15 cases of type A2, 9 cases of type A3, 7 cases of type B3, 11 cases of type C1, and 12 cases of type C2. Of them, 52 patients had closed fractures and 10 had open fractures. Ten open fractures included 6 Grade I fracture and 4 Grade II fracture.\textsuperscript{13,11}

Mushtaq A et al in a prospective study on 21 distal tibia fractures observed that, there were 12 Type A, 5 Type B, and 4 Type C fractures.\textsuperscript{12}

Faschingbauer M et al in a prospective study treated twenty-five patients with closed distal tibial fractures with a locked plate osteosynthesis over a period of two years. According to AO classification, there were three A1, eight A2, nine A3, one B2, two C1, and two C3 fractures.\textsuperscript{16}

Hence higher the velocity in road traffic accidents, higher the comminution at the fracture site.

Six (24%) patients developed superficial infection with wound healing problems. All of them healed with oral antibiotics. For one (04%) patients with skin necrosis debridement and ASD was done, and later wound closure was done. Late complications in form of persistent pain 4 cases (16%), mal-union 2 cases (08%), non-union 1 case (04%), deep infection 1 case (04%), were also seen. In patient, where deep infection was present, implant removal was done.

Hazarika S et al in a prospective study reported their experiences with minimally invasive locking plate osteosynthesis (MIPPO), For distal tibia fracture, with specific reference to fracture union and complications encountered in 20 patients with open or closed tibial fractures. Three out of 20 patients require metalwork.
removal, for delayed wound breakdown in two cases and wound infection in one case. An uneventful recovery was made following this in all three cases.11

Bahari S et al in a prospective study on 42 patients reviewed at a mean of 19.6 months after treatment of distal tibial and pilon fracture using AO distal tibial locking plate with a minimally invasive Percutaneous plate osteosynthesis (MIPPO) technique. Mean time to union was 22.4 weeks, all fractures united with acceptable alignment and angulation.17

Zha G et al in a prospective study performed on 13 patients with tibial fractures treated with indirect reduction and minimally invasive Percutaneous LCP internal fixation. All patients were followed up for 10-18 months (13 month on average) all fractures reached clinical healing, and the healing time was 12-20 weeks (16 weeks on average).18

Mushtaq A et al in a prospective study author reviewed 21 patients with distal tibia fracture treated with LCP internal fixation. AO type 43A, 43B and 43C were included, The mean time to union was 5.5 months (range 3-13 months) seventeen fractures healed with good functional outcome. One patient had delayed union. One patient had non union and underwent revision; the fractures ultimately healed with good functional outcome.12

Protzman R et al in a prospective study on 38 patient observed one case (3%) of Valgus malalignment observed on immediate postoperative radiographs of this patient which healed with no change in alignment. The other patient had varus malunion at 6 month follow up.

Hence, union rate in our study corroborates with above discussed studies.

Malunion was observed in two (08%) patients. Valgus mal alignment was observed on immediate postoperative radiographs of this patient. Valgus mal alignment was observed on immediate postoperative radiographs of this patient which healed with no change in alignment.
Gupta RK et al in a retrospective study reviewed distal metaphyseal tibial fractures in a 79 patients treated with locking plates, observed two cases of delayed scar breakdown resulting in aseptic exposure of plate, one required subsequent fasciocutaneous flap. Another patient required only plate removal as the fracture had united. Hence the result of this study corroborate with the contemporary literature relevant to distal tibia fracture fixation performed with various locking plates. Therefore, locking compression plate is a good device to stabilise the fracture of the distal tibia especially when used with skill along with minimum handling &preservation of the soft tissue. Care must be taken to motivate the patients for their involvement in rehabilitation programme.

VIII. Conclusion

Fractures of the distal end tibia are commonest in young and middle aged population. Majority of patients who suffered a fracture of distal end of tibia were males due to high velocity road traffic accidents. In our study, 36% of patients had associated injuries signifying the severity of trauma. Most common were type A fractures (64%), and amongst them A3 was the commonest subtype; 19 patients had closed fractures (76%), while 6 had open fractures (24%). Infection occurred in 8 patients & was managed accordingly. Mean time to union was 19.13 weeks. Physiotherapy started from 2nd -3rd post operative day according to tolerance of patients and associated injuries. First Partial &then full weight bearing was started after the clinical and radiological healing of fracture.

Thus locking plates are a good device to stabilize the fractures of the distal tibia. Especially when used in conjunction with meticulous intraoperative handling of soft tissue and active participation of patients in rehabilitation programme.

Bibliography


DOI: 10.9790/0853-1705011420 www.iosrjournals.org 20 | Page