International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2021; 7(1): 670-674
© 2021 IJOS
www.orthopaper.com
Received: 10-10-2020
Accepted: 12-12-2020

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A review of minimally invasive technique using locking compression plate for fractures involving distal tibia

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DOI: <https://doi.org/10.22271/ortho.2021.v7.i1k.2556>

Abstract

Distal tibia fractures are one of commonest lower extremity fracture. The treatment is quite challenging, since it has poor vascularity and limited soft tissue coverings. There are various treatment modalities for the management of distal tibia fractures. Minimally Invasive techniques using locking compression plate has emerged as a popular treatment option because of its respect towards the biology of distal tibia, maintenance of fracture haematoma and providing a biomechanically stable fixation. It also has an advantage of early mobilization and minimal complications with a relatively higher rates on union. In this review article, we will evaluate the effectiveness of minimally invasive techniques for fractures involving distal Tibia.

Keywords: Distal tibial fracture, minimally invasive percutaneous plate osteo-synthesis (MIPPO), locking compression plate (LCP)

Introduction

Distal tibial fractures are one of the commonest fractures that occur because of injuries that occur due to high impact [1]. The distal part of the tibia is more prone for injury as it is a subcutaneous bone that has very less soft tissue coverage, and less blood supply. With the recent trend of rising numbers of high velocity injuries, cost-effective treatment of distal tibial fractures is of high demand. The Intra-articular distal tibial fractures are also known as "Pilon fractures or Tibial Plafond Fractures" [2-4].

Distal tibial fractures are usually difficult to reduce and stabilize as they have a tendency towards increased local complications following the classic osteo synthesis using metallic plates or the intramedullary nailing or using the external fixators [5]. Many clinical studies have been conducted in order to analyze the clinical and functional outcomes of the distal tibial fractures.

Minimally Invasive Percutaneous Plate Osteo-synthesis (MIPO) is a commonly adapted technique used to treat the distal tibial fractures [6-8]. Separate proximal and distal incisions are made to insert the plate through percutaneous method. This technique helps to reduce soft tissue loss and helps conserving fracture hematoma and blood supply to the fracture fragments. Using MIPO technique, direct exposure of the fracture site can be avoided and the implants can be transformed into an internal extra-medullary splint.

Minimally Invasive Percutaneous Plate Osteo-synthesis (MIPO) is observed to have better post-operative outcomes and therefore is greatly recommended in fractures involving distal tibia in order to avoid excessive soft tissue loss and unnecessary stripping of the periosteum [9]. The major goals of management of this type of fractures are reviving the normal anatomical alignment of the bones and their joint compatibility.

Hence, in this study, we aim to evaluate the clinical and functional outcomes in patients with fractures of distal tibia and who were treated by locking compression plate through MIPPO technique and assessed using Teeny & Wiss criteria [10-13, 30].

Methodology

Extensive search of articles was done electronically using databases like PUBMED, Google scholar, reference checking. Since the type of studies are different and the outcomes are measured using various different methods, a narrative review was appropriate for this study. Number of articles found were 241, in which 10 studies were selected which satisfied the inclusion criteria. The articles were from August 2000 to May 2020.

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Table 1: Teeny and Wiss criteria—symptoms and evaluation of functional outcome of the ankle parameters with corresponding points

1. Pain	
a) No pain, including long walks, running or sports.	50
b) Slight or occasional pain, pain after long walks or sports, or mild pain at end of day.	45
c) Mild pain with walking or running, but no change in activities of daily living. May have some pain going up or down stairs or walking on uneven ground. May require non-narcotic pain medicine several times a week.	40
d) Mild-moderate pain, tolerable, but requires some concessions to pain. May required daily non-narcotic pain medicine. No night pain.	30
e) Moderate pain. Definite change in activities of daily living pain at rest or at night, despite restriction of activities. Occasional weak narcotic needed.	20
f) Continuous pain, regardless of activity, most often not relieved with non-narcotic medication. Dependent on narcotic pain medicine for significant pain relief. Severe limitations of activities.	10
g) Disabled because of pain. Constant pain, no relief with medicines	0
2. Distance	
a) Unlimited	8
b) Limited, but greater than 6 blocks	6
c) 4 - 6 blocks	4
d) 1 - 3 blocks	2
e) Indoors only	1
f) Bed-chair, or unable to walk.	0
3. Supports or Orthosis	
a) None	8
b) Soft wrap needed for long walk	7
c) Cane or orthosis, only for long walks	6
d) Cane, single crutch or orthosis full time	4
e) Two canes or two crutches	2
f) Walker or unable to walk	0
4. Running	
a) Unlimited, as such as desired	5
b) Limited, but able to run	3
c) Unable to run	0
5. Toe raising	
a) Able to raise on toes x 10 repetitions	5
b) Able to raise on toes x 5 repetitions	3
c) Able to raise on toes x 1 repetition	1
d) Unable to raise on toes	0
6. Hills (up or down)	
a) Up and down normally	3
b) Climbs and/or descends with foot externally rotated	2
c) Climbs and/or descends on toes or by side stepping	1
d) Unable to climb and/or descend hills	0
7. Stairs (up or down)	
a) Climbs and descends normally	3
b) Needs banister	2
c) Steps down and/or up with normal foot only	1
8. Limp	
a) None	8
b) Only when fatigued	6
c) Slight, constant	4
d) Moderate, constant	2
e) Marked 0	

9. Swelling	
a) None	3
b) Only in the evening or after walking	2
c) Constant, mild (less than 1 cm difference around calf)	1
d) Marked 0	
10. Plantar range of motion	
a) Greater than 300	2
b) Greater than 100	1
c) Less than 100, or presence of equinus contracture	0
11. Dorsal range of motion	
a) Greater than or equal to 150	5
b) Greater than or equal to 100, less than 150	4
c) Greater than or equal to 00, less than 100	3

Fig 1: AO/OTA classification system type 43 distal tibial fracture

Table 2: Table of classification of functional outcome of the patients based on the scores assigned using Teeny & Wiss criteria

Rating	Results
Excellent	(>92 points)
Good	(87-92 points)
Fair	(65-86 points)
Poor	(<65 points)

Results

RM Mallikarjuna Reddy *et al.* concluded that the mean age of patients with distal tibial fractures was 45 years of age (range of 23 to 70 years of age) with most patients presenting with a fracture between 31 to 40 years of age. This observation was very close to a similar study performed by Cory collinge *et al.* (45) in 2010, where the mean age of presenting with this fracture was 43 years of age (ranging from 17 to 62 years of

age) [14, 29].

In 2011, Shrestha D *et al.* observed that the average age of the patients with similar fractures, was 34 years of age (ranging from 17 to 65 years of age).

In 2013, Abdulla S *et al.* conducted a similar study and concluded that the average age of occurrence was 32 years of age. All these studies suggested that middle-aged individuals are more often injured with distal tibial fractures. (52) The study included 21 male patients (52.5%) and 19 female patients (47.5%); 25 patients (62.5%) with injury to the right leg while 15 patients (37.5%) had injury to the contralateral side. Most patients (80%) reported with a history of road traffic accidents. In our study, we also observed a male predominance for such kind of high velocity injuries [15, 28].

This is almost similar to the observations made by other studies conducted by JJ Guo *et al.*, Mauffrey C *et al.* and

Somasekhar *et al.* where they observed a male predominance of 50%, 66%, 75% respectively, due to the likelihood of male dominance over females in road traffic accidents, occupational injuries, domestic injuries etc. in our Country [16]. The average time interval between the time of injury to the time of surgery, in this study, was about 3.6 days; the standard deviation was 1.99 days; the median was 3 days and the mode was 2 days. The minimum time interval between time of injury and surgery was 1 day and the maximum was 10 days [17].

In their study, RM Mallikarjuna Reddy *et al.* observed that the average duration of delay in the surgeries was 4.27 days, following the injury (50). It is comparable to the study conducted by Shrestha D *et al.* (2011) on distal tibial fractures which concluded that the average interval between time of injury and time of surgery was about 4.45 days [18].

In a study by A Vishnusankar *et al.*, all the operated cases were observed to have undergone complete bony union in a mean duration of about 18.28 weeks [19].

While conducting a study of minimally invasive techniques for fractures involving distal tibia, Nicola Maffulli MD & Mario Ronga MD *et al.* observed that, they could establish union in 20 out of the 21 cases they studied while one case resulted in non-union [20].

Evaluating the management of distal tibial fractures using the MIPPO technique, Hassan A Neinaa *et al.*, observed that, on an average, the fracture union was seen within 16-23 weeks. They observed union in 16 cases within 16-20 weeks, delayed union (attained within 23 weeks [mean: 19.2 weeks]) in 3 patients and one case of non-union [21, 27].

In 2015, Shikhar D Singh *et al.* observed a significantly low rate of superficial wound infection after MIPPO with only about 10% of their study population being affected. There were no cases of wound dehiscence detected in the study group, as MIPPO technique was a minimally invasive method and made use of anatomically contoured distal tibial locking plates [22].

While studying the functional and radiological outcome of 25 patients with distal tibial fractures, who were surgically managed by MIPPO technique using anatomical locking compression plates of distal tibia, Shobha H. P *et al.* observed that, it is an effective method for stabilization of these fractures and that it allows early recovery and range of motion at ankle joint done in complicated fractures where intramedullary nailing would be difficult. The study also concluded that with the use of MIPPO technique, the incidence of non-union of distal Tibial fractures was observed to be significantly low and that it could provide better bone healing thus reducing the need for a bone grafting [23-26].

Conclusions

Majority of the study population belonged to the age group of 31 to 40 years of age with 21 male patients and 19 female patients. About 80% of the patients presented with history of road traffic injury. The results of operative management were solely dependent on the severity of injury and the quality and stability of the fixation performed. We observed that the mechanism of injury, the status of the soft tissues and the degree of comminution affects the clinical result in long term. MIPPO with LCP is a most reliable and effective method of management for the distal tibial fractures, preserving most of the bony vascularity and hematoma surrounding the fracture site, thus resulting in a better biological repair. The incidence of delayed union and non-union is significantly reduced in this technique due to the preserved bony vascularity. Limited

exposure, careful dissection of soft tissues and reduced operating time leads to relatively decreased incidence of post-operative infections.

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