



COMPARATIVE STUDY BETWEEN MEDIAL AND LATERAL DISTAL TIBIAL LOCKING COMPRESSION PLATES FOR DISTAL THIRD TIBIAL FRACTURES

Orthopaedics

Dr. Rajat Saini	Junior Resident, Department of Orthopaedics, Mahatma Gandhi Medical College and Hospital, Jaipur, Rajasthan, India.
Dr. R. K. Verma	Professor and Unit Head, Department of Orthopaedics, Mahatma Gandhi Medical College and Hospital, Jaipur, Rajasthan, India.
Dr. S. P. Gupta	Professor and HOD, Department of Orthopaedics, Mahatma Gandhi Medical College and Hospital, Jaipur, Rajasthan, India.
Dr. Rajat Jangir*	Associate Professor, Department of Orthopaedics, Mahatma Gandhi Medical College and Hospital, Jaipur, Rajasthan, India. *Corresponding Author
Dr. Raj Kumar Bairwa	Assistant Professor, Department of Orthopaedics, Mahatma Gandhi Medical College and Hospital, Jaipur, Rajasthan, India.

ABSTRACT

Aim and objectives: to compare both the ways of fixation in randomly selected cases in distal third tibia fractures to know the best way of fixation technique & implant. **Material and methods:** In our study we have selected 40 patients with fractures of the distal third tibia, who attended the department of orthopaedics treated by open reduction and internal fixation with using Medial/Lateral distal locking compression plates, in Mahatma Gandhi Medical College & Hospital, Jaipur during the year January 2019 to June 2020. The duration of follow-up to evaluate result was six months. We divided the distal leg bone fractures into two groups. Group 1: Include the distal third tibial fractures which are simple or comminuted treated as open reduction & internal fixation with lateral locking compression plate. Group 2: Includes the distal third tibial fractures which are simple or comminuted, treated as open reduction & internal fixation with medial locking compression plate. **Results:** There was no significant difference in duration of surgeries and suture removal. In there were 3 cases of nonunion 1 case in lateral plating group and 2 cases in medial plating group. Group 1 were show 20% excellent, 45% good, 30% fair & 5% poor result. Group 2 were show 15 % excellent, 30% good, 45% fair & 10% poor result according to Tenny & Wiss criteria. **Conclusion:** Lateral plating was much better in as a procedure and outcome wise.

KEYWORDS

INTRODUCTION

As the civilization proceeds towards industrialization more and more accidents have been experienced. It's almost all over the world, the incidence of road traffic and industrial accidents are growing up, resulting poly-trauma which leads multiple bone fracture. If we go through the statistics of fractures in human body then leg bones fracture commonest bone injury, because it is the most distal part of the body and actively involves in locomotive system. Out of all the leg bones fracture, a significant number of cases are of distal tibia, which are generally comminuted in nature and are unstable. The fracture of distal third of tibia has proved to be a double edged sword for orthopaedic surgeons in a sense that it often ends up with unsatisfactory result on surgical intervention and non union is a common problem on the conservative approach.

High energy distal tibial fractures involve concomitant fibular fractures 80% of case.[1] The concomitant fibular fixation in distal third tibia fracture is important as it helps in accurate restoration of the articular surface of tibia and lesser the risk of distal tibia malalignment and shortening.

The interosseous membrane between the tibia and fibula has been shown to function as conduit for stress transmission, creating a load sharing function of fibula. When the interosseous membrane disrupts, the tibia will bear most of the weight bearing stress. The fibula also contributes to the biomechanical stability of the ankle mortise during gait. So that fibular fractures associated with syndesmotic or mortise instability should be stabilized otherwise malreduction of the ankle mortise will occur that will result in poor functional outcome.

Fracture distal third tibia simple or comminuted, closed or compound has been known since the Hippocrates and difficult to treat since then. Earlier all the fracture distal third were known as pott's fracture after the name of Sir Percivall Pott's (1768).[2]

Later over decades different terminologies were used in regards to tibia fracture, their mechanisms and classification. However, problems associated with lower third fractures and management of such fracture has not met with any significant improvement.

Ashurst and Bromer (1922) classified distal third fracture successfully

but management part had been neglected.[3]

Since then various classification system have been advocated by authors like Wepenis, Muller et al.,[4] AO/ASIF group and have been time to modified by various organizations to improve the reproducibility and validity of these system.

Most detailed classifications is given by AO/ASIF classification which is simple and has been an effective tool not only to evaluate mechanism of injury and severity but also to judge prognosis and a reliable guide to reach an efficient clinical and management judgment. Soft tissue injuries in vicinity have also been classified and accepted worldwide now by Gustillo's (1976).[5]

Thousands of years ago Egyptians immobilized fractures by linen stiffened with gum plasters. Latter Krause (1887) used walking plaster to treat these fracture without fruitful result. Lane (1909) & Lambotte (1912) first introduce fracture management by open techniques.[6]

A variety of treatment methods have been suggested for these injuries including non operative treatment, external fixation intra medullary nailing, Lag screw and plate fixation. Further complicated cases which were even involved intraarticular surface can be fixing with good AO fixation system which comes well designed anatomical medial & lateral plates. In our study we have taken a challenge to compare both the ways of fixation in randomly selected cases in distal third tibia fractures to know the best way of fixation technique & implant.

In this study we divided the distal leg bone fractures into two groups.

Group 1:-Include the distal third tibial fractures which are simple or comminuted treated as open reduction & internal fixation with lateral locking compression plate.

Group 2:- Includes the distal third tibial fractures which are simple or comminuted, treated as open reduction & internal fixation with medial locking compression plate.

MATERIALS AND METHODS

In our study we have selected 40 patients with fractures of the distal third tibia, who attended the department of orthopaedics treated by

open reduction and internal fixation with using Medial/Lateral distal locking compression plates, in Mahatma Gandhi Medical College & Hospital, Jaipur during the year January 2019 to June 2020. The duration of follow-up to evaluate result was six months.

1. Patient selection: Patient selection was based on very liberal inclusion criteria.

- Age group between 18 to 60 irrespective of sex
- Fracture involving distal third of tibia
- Extra articular fracture
- Gustilo type I
- Unilateral fracture
- Patients willing to give consent

Patients admitted to emergency department with fracture distal third tibia with inclusion criteria, included in our study. Best possible treatment available was restored after primary management of patient in poly-trauma setup.

2. Management protocol: the management of injury was based on the following protocol

Initial management and resuscitation:

- a) After admitting the patient in emergency, his vital parameters checked and patient managed accordingly.
- b) Thorough examination of patient and appropriate investigation ordered to rule out any associated chest, abdomen and head injury.
- c) A good quality of X-Ray both AP and lateral view was done. An intravenous line was established; fluid replacement was started and in case of open fracture bleeding was controlled by pressure bandage and immobilization of fracture site done along with limb elevation.
- d) A tetanus prophylaxis and intravenous antibiotic and analgesic were given.
- e) Once patient was settled from acute injury then Definitive fracture management was restored.
- f) Detail record keeping was done and fracture classification as per AO classification.
- g) There are three types of fracture in AO classification these are-

Distal Tibia - (AO / OTA) Classification

(From Orthopaedic Trauma Association Committee for Coding and Classification: Fracture and dislocation compendium, J Orthop Trauma 10 (Suppl 1):1, 1996.)

43 A - Distal Tibia Extra Articular Fractures

A1 - Extra articular fracture, metaphyseal simple.

A2 - Extra articular, metaphyseal wedge.

A3 - Extra articular fracture, metaphyseal complex.

43 B - Distal tibia Partial articular fractures

B1 - Partial articular fracture, pure split.

B2 - Partial articular fracture, split depression.

B3 - Partial articular fracture, multi fragmentary depression.

43 C - Distal tibia complete articular fractures

C1 - Complete articular fracture, articular simple, metaphyseal simple.

C2 - Complete articular fracture, articular simple, metaphyseal multifragmentary.

C3 - Complete articular fracture, multi fragmentary.

Patients were randomized through chit and box method and divided under two groups –

- Group 1:- Total 20 patients were treated by open reduction and internal fixation by lateral plating
- Group 2:- Total 20 patients were treated open reduction and internal fixation by medial plating

Operative procedure :

In lateral plating group, lateral approach was performed as described by Manninen et al.[7] and In medial plating group, medial approach was performed as described by Clifford et al.[8]

Post operative care

The limb was elevated and active toe movement and static quadriceps exercise were started. Check X-ray was done. The patient was watched for any abnormal swelling and distal circulatory disturbance.

After two weeks suture was removed and partial weight bearing according to fracture pattern and stability of fixation.

Follow up and evaluation

The patient were seen on outdoor basis at 4 weeks 6 weeks, 12 weeks & 24 weeks and a check X ray was done for radiological union & weight bearing according to fracture pattern and stability of fixation.

Final Analysis was done both radiologically and functionally

- Callus in at least 3 cortex would be considered union.
- Patient able to walk without support without pain would be considered union clinically.
- Tenny & Wiss Criteria symptoms and functional evaluation would be used to evaluate functional outcome
- No callus formation for at least 9 months in any of the cortex would be defined as Non union.

Tenny & Wiss Criteria Symptoms and functional evaluation

1. Pain

- a) No pain: 50
- b) Slight or occasional pain: 45
- c) Mild pain with walking or running: 40
- d) Mild pain required daily non-narcotic pain medicine. No night pain : 30
- e) Moderate pain occasional weak narcotic needed : 20
- f) Continuous pain Dependent on narcotic pain medicine : 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 30°: 2

- b) Greater than 10°: 1
c) Less than 10°, or presence of equinus contracture: 0

11. Dorsal range of motion

- a) Greater than or equal to 15°: 5
b) Greater than or equal to 10°, less than 15°: 4
c) Greater than or equal to 0°, less than 10°: 3

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

STATISTICAL ANALYSIS

Statistical analysis

The data was coded and entered into Microsoft Excel spreadsheet. Analysis was done using SPSS version 20 (IBM SPSS Statistics Inc., Chicago, Illinois, USA) Windows software program. Descriptive statistics included computation of percentages, means and standard deviations. The Mann Whitney u test (for quantitative data to compare two independent two groups) was used for quantitative data comparison of all clinical indicators. Chi-square test was used for qualitative data whenever two or more than two groups were used to compare. Level of significance was set at $P \leq 0.05$.

RESULTS:

In our study we included all patients between 15 to 63 years age. The mean age was 40 years. The most common affected patients were of age of 35-44 years which accounts for 40%. The youngest patient was 20 years of age and the oldest was 65 years age. Males were predominantly affected in our study accounting for 80% as compared to females (20%). The male female ratio was 4:1. Almost half of the patients affected were either farmer or labour. There were working outside and more mobile hence more susceptible to trauma or accidents. There was significant predilection for the right side as compared to left affecting 2 times more than left.

Commonest mode of injury was high velocity road traffic accidents. In our study these account for 82.5%. The reason was because of technological advancement and advent of faster conveyance and better road facility, increase in no. of vehicle due to fast living style, ignorance of traffic rules and over crowding, untrained people drive vehicle & inappropriate safety measures taken and assault, fall from height were other common causes of injury.

We included both closed and open type of injuries in both the study groups. Closed injuries were classified with T scheme system and open injuries were classified according to Gustilo Anderson classification. Open injuries involved in our study were grade 1 type.

Most common fracture pattern seen in our study was type A1. Type A2 was second most common followed by A3. We restricted our study to distal juxta-articular fracture of leg bone purely extraarticular in our study most common fracture pattern seen in our study was type A1. Type A2 was second most common followed by A3.

All patients included in our study suffered from fibular fracture during our study period. It was rare to see any distal juxta-articular fracture involving only tibia.

In our series almost 62.5 % patients were operated within 24 hrs of injury and mean injury surgery interval was 2.7 days. The injury surgery interval was prolonged in those patients, who were admitted late after injury or having other associated injuries like head injury, chest injury or BTA.

There was no significant difference in duration of surgeries and suture removal. Average time depends on surgeon skills, fracture patterns, or any associated complication during surgery.

Complication rate were higher in medial plating group as compared with lateral plating group because medial plate placed under the skin over anteromedial tibia.

Table 1: Duration of partial weight bearing

Duration in week	Group 1		Group 2	
	N	%	N	%
1-3 weeks	17	85	15	75
4-6 weeks	3	15	5	25
7-9 weeks	-	-	-	-
>10 weeks	-	-	-	-
mean±SD	2.8±1.1		2.8± 0.83	

P value=0.89

We encouraged partial weight bearing on the affected extremity as soon as possible.

In Group 1 mean duration of partial weight bearing was 2.8 weeks and 85% cases, partial weight bearing was within 1-3 weeks. In Group 2 mean duration of partial weight bearing was 2.8 weeks and 75% cases, partial weight bearing was within 1-3 weeks.

Table 2: Full weight bearing

Duration in week	Group 1		Group 2	
	N	%	N	%
4-8 weeks	1	5	-	-
9-12 weeks	16	80	14	70
13-16 weeks	2	10	2	10
17-20 weeks	-	-	2	10
>20 weeks	-	-	-	-
Pt unable to full weight bear	1	5	2	10

P value=0.67

In Group 1:- there were 80% cases started full weight bear in 9-12 weeks, 1 case unable to full weight bear because of nonunion. Group 2:- 70% cases was started full weight bear in 9-12 weeks, 2 cases unable to full weight bear because of nonunion.

Table 3: Radiological union among groups

	Group 1		Group 2	
	N	%	N	%
Union	19	95	18	90
Nonunion	1	5	2	10

P value=0.38

There were 3 cases of nonunion 1 case in lateral plating group and 2 cases in medial plating group.

Table 4: Post operative hardware removal among study group

			Hardware removal		Total
			No	Yes	
Groups	Group 1	N	18	2	20
		%	90.0%	10.0%	100.0%
	Group 2	N	13	7	20
		%	75.0%	35.0%	100.0%
Total		N	31	9	40
		%	77.5%	22.5	100.0%

P value= 0.05

Group 1:- only 10% cases underwent to secondary procedure for hardware removal. Group 2:- 35 % cases underwent to secondary procedure for hardware removal is because of discomfort produce by the medial plate placed under the skin over anteromedial tibia.

Table 5: Comparison of Tenny & Wiss criteria score at final follow up

Score	Group 1		Group 2		Total	
	N	%	N	%	N	%
Excellent	4	20	3	15	7	17.5
Good	9	45	6	30	15	37.5
Fair	6	30	9	45	15	37.5
Poor	1	5	2	10	3	7.5

P value= 0.73

Group 1 were show 20% excellent, 45% good, 30% fair & 5% poor result. Group 2 were show 15 % excellent, 30% good, 45% fair & 10% poor result.

Table 6: Comparisons of result among study group

Results	Group1	Group2	P value
Operative time(min)	55.50	56.75	0.59
Union rate	19/20	18/20	0.38
Symptomatic hardware	7/20	14/20	0.02(s)
Implant failure	1/20	1/20	NA
Hardware removal	2/20	7/20	0.05
Superficial infection	1/20	4/20	0.63
Wound dehiscence	1/20	3/20	0.29
Result grading (excellent/good/fair/poor)	4/9/6/1	3/6/9/2	0.73

DISCUSSION

The management of distal third leg bones fractures remains challenging. In the past most authors concluded that all distal third leg bone fractures are to be treated conservatively and are not amenable to open reduction and internal fixation because most distal fracture involve weight bearing surface of ankle joint and are mostly comminuted. Further proximity of these fractures to ankle make the surgical intervention more complicated, resulting in unacceptable deformity and ankle stiffness. But in modern era of internal fixation where all fracture are fixed with improved surgical techniques and better armamentarium. The surgeons thought to fix these fractures as the patient also demand to as soon as possible, to rich his day to day activity. Further complicated cases which were even involved intra-articular surface can be fixed with good AO fixation system which come well designed anatomical medial and lateral plates.

On reviewing the literature on distal tibial fracture we found that most authors have classified then into several groups based on certain characteristics which will decide what treatment that group would receive. In our study we have taken a challenge to compare both the ways of fixation in randomly selected cases in distal third tibia fractures to known the best way of fixation technique & implant. We divided distal third leg bone fractures into two groups based on the treatment.

In present study total numbers of 40 patients were treated fracture of distal leg bones admitted through emergency in department of orthopedics at Mahatma Gandhi Medical College and Hospital, Jaipur during Jan 2019 to June 2020.

The fractures of distal leg bones mainly affect young age group of population. In our series more than 70% patient were young males below 45 years of age who were the central pillar of their family. Sarmiento A and Latta LL (2004) [7] and Rao H et al (1999) [8] also documented the similar incidence. Males were predominantly affected in over study accounting for 80% as compared to female (20%). This suggest that males more commonly involve in outdoor activities and drive vehicle that's why more prone to accident & trauma. It is not similar in other western study as in this part of world. In india males are mainly involved in hard labour like going out and other manual work. Incidence of female patients was significantly higher in Sarmiento A and Latta LL (2004) [9] series (28%). Rao H et al (1999) [10] series also have incidence similar to our series, having male (88.8%) and female (11.2%).

Occupation wise in our study 50% patients were farmer & labour then office worker & students another common group affected in our series accounting for 20% and 10% respectively. Like most other studies our study also reveals that occupation which involve working outside and hence more mobile are susceptible to trauma.

Incidence of right side limb involvement was significantly higher (62.5%) then left side (37.5%) in our series. As right side is dominate so right side commonly involve in injuries. The commonest mode of injury was high velocity and road traffic accidents accounts for 82.5% in present series. The incidence of injury due to RTA was almost similar to series of Pai V (2007) et al (89%) [11] and Krackhardt T (2003) et al (85%) [12]. The reason of high incidence of RTA can be attributed to better road facilities and technological advancement with increase number of vehicles and ignorance of traffic rules. Assault, fall from height were other causes of injury. The road traffic accidents were associated with high velocity trauma and high incidence of other associated injury of the body. In present series 25% distal tibial fractures were isolated injury and rests 75% associated with fibula fracture. That also collaborates with world literature.

In this series closed fractures were more common (72.5%) as compared to open fracture (27.5%) because in our study open injuries involved only grade 1 type.

In this series we have tried to operate the patients as soon as they come to hospital. About 62.5% patients were operated with in 24 hrs of injury and the mean interval between injuries to surgery was 2.7 days. The interval between injuries to surgery was prolonged in cases who were admitted late after injury or having associated injury like head injury etc. which involve other specialties and even some times patient economic condition delay the surgery which we never notice.

In our series we encouraged partial weight bearing on affected extremity as soon as possible. As AO postulated early fixation with early mobilizations is the main goal. We also encourage the same by very fast active & passive mobilization of ankle even partial weight bearing or with the three point gait. In both study groups partial weight bearing started in 1-3 weeks. Patient started full weight bearing early in who treated with lateral plating. Similar result found in Maffulli Net al (2007) study.[13]

In our study complication rate little higher in medial plating group out of 20 patients 4 patients had superficial infection, 3 patients had wound dehiscence compare with lateral plating only 1 patient had superficial infection and 1 patient wound dehiscence. Symptomatic to hardware were more common problem with medial plating group but was unusual in lateral plating group due to lateral plate was placed beneath the anterior compartment muscle with thick soft tissue coverage. 14 patients request for hardware removal in medial plating group due to more superficial which irritating to patients. In lateral plating group only 7 patient requests for hardware removal. There were 2 cases nonunion in medial plating group and 1 in lateral plating group. In the final follow up, functional outcomes were evaluated using Tenny and Wiss clinical assessment criteria. The number of cases graded as excellent/good/fair/poor was 3/6/9/2 in medial plating group and 4/9/6/1 in lateral plating group respectively. Similar data found with study of Garg S et al (2017) [14] and Lee et al (2009) [15].

So we feel at the end of study in the both group medial or lateral plating using medial implant & lateral implant. Lateral plating was much better in as a procedure wise & outcome also. But our study is too small number & also very small duration of time further long series make definite advised about which the best technique is.

It also gives us confidence during the study that every case has taught us to more confident of doing this procedure. It all depends on surgeon to surgeon experience & surgical skills.

CONCLUSION

At the outset of study, we have found that lateral plating was much better in as a procedure and outcome wise.

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