(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 6, Issue 1 , Page No: 352-361
January-February 2023

IJMSCR

Management of Distal Tibial Fractures – A Clinical Study

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Type of Publication: Original Research Paper
Conflicts of Interest: Nil

Abstract

Background: Fractures of distal tibia are relatively rare but complex injuries. These are associated with high complication rates and poor functional outcomes. Poor outcome may be attributed to several factors like limited soft tissue envelop, poor vascularity, proximity of the fracture to the ankle joint, associated soft tissue injuries.

Materials and Methods: 17 skeletally mature patients with extra-articular fractures of distal tibia were treated with different treatment modality like ORIF with plating, CRIF with nailing, external fixator application and limited internal fixation (k-wire) from November 2020 to November 2022.

Results: All fractures except 1 (treated by intramedullary nailing) united well in our study. The average functional score calculated using the AOFAS scale was 82.62 at final follow up. Excellent result was achieved in 6 cases, good in 4 cases, fair in 5 cases and poor in 2 cases.

Conclusion: Managing the fractures of distal tibia remain a therapeutic challenge for orthopaedic surgeons. Not a single treatment method can be universally applied in management all distal tibial fractures. Future prospective randomised trials with adequate sample size and longer follow-up are needed to devise the optimal treatment protocol for the management of these injuries with greater accuracy.

Keywords: Distal tibia, Tibial pilon

Introduction

Distal tibial fractures is relatively a rare injury. Incidence wise fractures of distal tibia comprises 3% to 11% of all fractures of tibia or around 1% of lower extremity fractures. It may be either extra-articular (AO-43A), partial intraarticular (AO-43B) or complete intraarticular (AO-43C). Distal tibial fractures may be caused due to high energy tauma like road traffic accident, fall from height or low energy trauma like twisting injury. Upto 50% of fractures involving distal tibial are compound but fractures which are closed also suffer significant soft tissue injury. [1]

Managing fractures of distal tibia adequately is a therapeutic challenge for most orthopaedic surgeons. The goal of management is to restore the anatomy of distal tibia, to fix the epi-metaphyseal block in proper alignment and rotation with the diaphysis and to avoid complications as far as possible. These injuries are particularly challenging to manage due to limited soft tissue coverage, poor vascularity of the area, proximity of the fracture to the ankle joint, associated soft tissue injuries. Optimal treatment method for distal tibial fractures is still debatable in literature. Treatment depends on type of fracture, comminution & soft tissue injury. Different treatment modalities described for distal tibial fractures are plating either by conventional open technique or by MIPO technique, closed reduction and internal fixation with nailing, external fixator application, limited internal fixation (k-wires, screws), staged surgery or conservative treatment. [2]

In our study we will use different treatment method for distal tibial fractures and note the outcome in each

and try to give a treatment protocol for management of distal tibial fractures.

Materials And Methods

This prospective study was conducted in the department of Orthopaedic surgery, Jawaharlal Nehru Medical College, Aligarh Muslim University Aligarh. The study duration was from November 2020 to November 2022. A total of 17 patients were included in this study. Prior to study approval was taken from the Institutional Ethics Committee.

Inclusion Criteria

Skeletally mature patients with fractures of distal tibia, fracture line should extend within two muller square from ankle joint. Fracture to be included should be either fresh or upto 3 weeks old. In case of open fractures the fracture should fall in Gustilo Anderson grade 1, 2, 3a or 3b.

Exclusion Criteria

Pathological fracture, any congenital limb deformity in the fractured leg, polio affection of fractured limb, associated vascular injury i.e fracture falling in gustilo Anderson grade 3c.

Preoperative Workup

After clinical assessment (history & examination), if patient found suitable for the study, was briefed about the type of treatment. Written informed consent was taken for the same. The details of the patient was taken according to the proforma. X-ray of ankle joint Antero-Posterior/Lateral/Mortise view & whole leg Antero-Posterior/Lateral view was done. Fracture classified according to AO classification. Soft tissue injury classified using Gustilo & Anderson classification. Depending on classification, skin condition, severity and fracture pattern appropriate treatment modality was chosen for patient on case to case basis.

Operative Procedure:

Appropriate treatment method was decided by the operating surgeon based on the fracture pattern, severity of comminution & soft tissue condition.

Seven patients were treated by internal fixation with plating. In 3 of these 7 patients MIPO technique was used and in rest 4 patients fracture reduction was achieved by conventional open technique.

Six patients were treated by closed reduction and internal fixation with nailing. Three out of them had closed fracture, two had grade 2 open injury and one of them had grade 1 open injury.

Three patients were treated with external fixator application. Two of them had grade 3 open fracture and one of them had closed comminuted fracture with severe soft tissue injury.

One patient with compounding fracture was treated with limited internal fixation (K-wires).

Follow Up And Assessment:

Patients were followed up regularly in OPD at 2 weeks then 6 weeks interval till union then 3 monthly. Patients were assessed both clinically and radiologically. Clinical assessment was done by calculating AOFAS score using standard proforma and marking patient's response on it. Also soft tissue complication and infection were noted if any. Radiological assessment was done on plain X-ray whole leg antero-posterior and lateral views and X–ray ankle joint antero-posterior, lateral and mortise view. Signs of union like callus was noted on x-rays. Also alignment was noted on x-ray.

Results

Out of 17 patients included, 13 were males and 4 were females. The average age of patient was 44.7 years (range 18 to 95 years). Minimum follow-up period was 7.4 months with a mean follow-up period of 12.92 months (range 7.4 to 20.4 months). Patients of different osteosynthesis group were similar as far as demograhic details were considered. However patients of different osteosynthesis group had wide variation in the injury data. It was noted in the study that external fixator as modality for management of distal tibial fractures was used mostly for open fractures.

Surgical complications was observed in 5 patients which comprises 29.5% of study sample. Superficial skin infection was noted in 2 cases comprising 11.7 % chunk of study sample, deep infection was noted in 2 cases comprising 11.7% of study sample and non-union was observed in 1 case comprising 11.7 % of study sample. The complication rate was found to be significantly higher for fractures falling in subgroup 3 of the AO/OTA classification as compared to those which fall in subgroups 2 or 1.

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Rate and type of complication was also significantly different according to the different osteosynthesis type.

At final follow up the average functional score was 82.62 points calculated using the AOFAS ankle-hindfoot scale (range 68 to 94 points). Excellent result was achieved in 6 cases, good in 4 cases, fair in 5 cases and poor in 2 cases. 10 patients had follow up duration of more than 9 months. Out of them AOFAS score was excellent in 6 and good in 4 cases. 7 patients had follow up less than 9 months. In them AOFAS score was fair in 5 and poor in 2 cases.

Table 1: Showing age distribution of study sample

Age of patients		
Age (Yrs)	No of patients	Percentage (%)
18-40	8	47.06
>40	9	52.94

Table 2: Table showing sex distribution of patients

Sex incidence		
Sex	No of patients	Perentage (%)
Male	13	76.47
Female	4	23.53

Table 3: Table showing mode of injury of patients

Mode of injury		
MOI	No of patients	Perentage (%)
RTA	12	70.59
FFH	1	5.88
FALL	3	17.65
FHO	1	5.88

Table 4: Table showing type of fracture

Type of fractures		
Type of fractures	No of patients	Perentage (%)
Closed	11	64.71
Open	6	35.29

Table 5: Table showing type of fracture (AO/OTA)

Type of fracture according to AO/OTA classification

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OTA	No of patients	Perentage (%)
A1	3	17.65
A2	7	41.18
A3	6	35.29
B1	1	5.88

Table 6: Tablet showing injury to treatment intervals (in days)

Injury treatment interval (days)		
interval (days)	No of patients	Perentage (%)
<3	8	47.06
03 to 05	3	17.65
>5	6	35.29

Table 7: Table showing different procedure done

Procedure		
	No of patients	Perentage (%)
Internal fixation	7	41.18
limited internal fixation (K-wires or screws)	1	5.88
external fixation	3	17.65
intramedullary nailing	6	35.29

Table 8: Table showing time to callus

Time to callus (weeks)		
Time to callus (weeks).	No of patients	Perentage (%)
<12	8	47.06
>12	8	47.06

Table 9: Table showing time to bony union in different patients

Time to Bony union		
Time to Bony union (wks)	No of patients	Perentage (%)
12 to 16 wks	8	47.06
>16 wks	8	47.06

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Table 10: Table showing time to full weight bearing (weeks)

Time to full wt. bearing (weeks)		
Time to full wt. bearing (weeks)	No of patients	Perentage (%)
12 to 16 wks	4	23.53
>16 wks	13	76.47

Table 11: Table showing complications in patient

Complications		
Complications	No of patients	Perentage (%)
Superficial skin infection	3	17.65
Deep infection	1	5.88
Varus malunion	2	11.76
Valgus malunion	2	11.76
Non union	1	5.88
Nil	9	52.94

Table 12: Table showing follow up duration

Follow up duration		
	No of patients	Perentage (%)
<9 months	7	41.18
>= 9 moonths	10	58.82

Chart 1: Line diagram showing AOFAS trend of patients

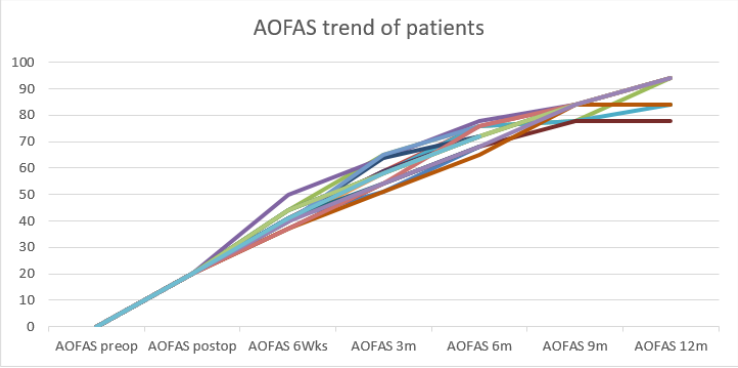

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Chart 2: Line diagram showing mean AOFAS of all patients

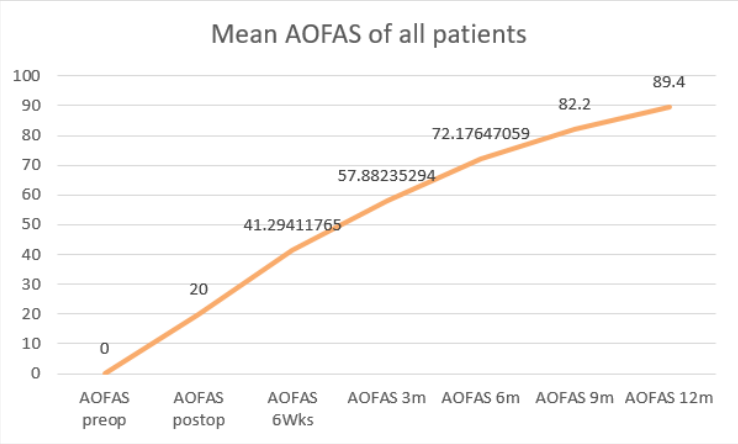
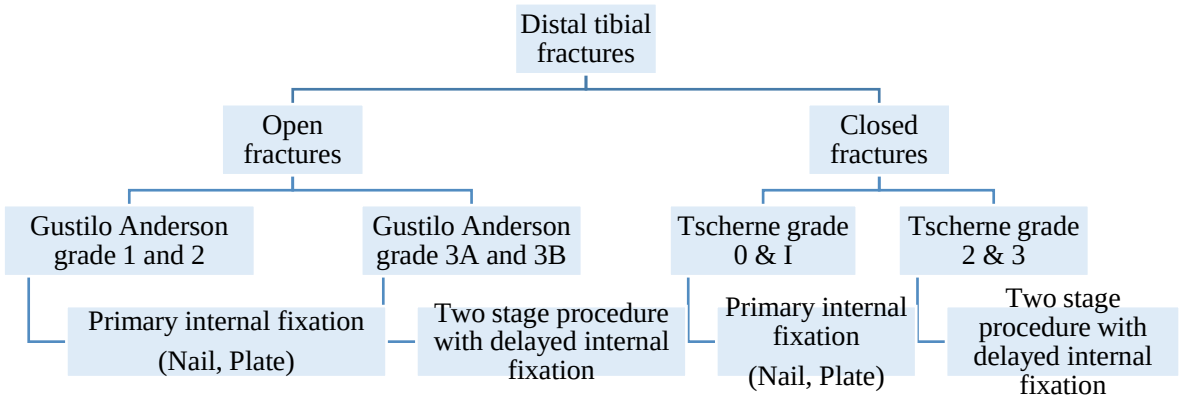


Table 13: Table showing functional outcome

AOFAS score		
AOFAS score	No of patients	Perentage (%)
Excellent	6	35.29
Good	4	23.53
Fair	5	29.41
Poor	2	11.76

Table 14: Table showing functional outcome in patients with >9m follow up

AOFAS score >9m		
AOFAS score	No of patients	Perentage (%)
Excellent	6	35.29
Good	4	23.53
Fair	0	0
Poor	0	0



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Discussion

This prospective study comprising 17 patients shows the difficulty in management of distal tibia fractures and the associated high complication rate with these fractures.

47% of patients had postoperative complications. Complications were mostly infections of superficial or deep nature, cutaneous problems, malunions and nonunion. This rate is comparable with other studies with rates ranging from 20% to 50% as reported by other authers [3, 4, 5, 6, 7, 8]. We observed a strong correlation between rate of different complication and initial fracture severity. In Similar fashion high fracture severity, complications and malunion were related with poor clinical results.

The best clinico-radiological results were discovered for the group of patients treated by early definitive internal fixation by plating by MIPO technique.

Open reduction and internal fixation using a plate allowed for proper and stable reduction of fracture with good functional outcome without any increase of cutaneous or infection complication rate. We found superficial infection rate of 14% in our patients treated by ORIF. This rate is similar to superficial infection rate found by other authors in their studies [5, 9]. Several authors reported much encouraging results with less infection rate in their studies [10, 11] whereas several other reported rates much higher than this [12, 13]. The better result in our study may be attributed to better skin condition at initial presentation, meticulous soft tissue dissection, good reduction and post-operative rehabilitation protocol.

In external fixation group, only three patients were there. They were managed on external fixation as definitive device. Two stage protocol was not applied to them to reduce their hospital visit. They were operated during the COVID-19 lockdown time and according to hospital guidelines minimum patient-hospital interaction was intended so they were managed by external fixator definitely.

Similar to many other studies, we also observed that definitive external fixation resulted in more malunion, stiffness or pain than primary internal fixation. [3, 6, 14, 15] Varus malunion was found in 2 out of 3 patients (66%) of patients treated with definitive external fixation where as only 14.2% patient developed valgus malunion treated by ORIF with plating and 16.6% patient developed valgus malunion who were treated by intramedullary nailing. Thus, according to us external fixation should exclusively be used for temporary fixation of fractures in two-staged protocols where fractures need to be fixed later with ORIF or limited internal fixation [16, 17].

All patients in our study had ipsilateral fibular fracture. This rate was more in comparison to rates near 80% found in other studies [14, 18, 19]. This discrepancy may be attributed to small sample size of our study as compared to other study.

There is no general consensus for the fibular fixation in the management of both bone leg fractures. Most of the authors found better results with fibular fixation [8, 20] while some found better results without fibular fixation [21, 22]. Some authors found inclusive results and recommended fibular fixation in specific situation [18, 23]. We recommend to fix fibular fracture with a plate as often as possible get an aid in restoration of tibial length, to overcome rotational forces and to avoid valgus mal-alignment in distal 1/4th fibular fractures. Out of the 17 patients included in our study 14 patients (82.3%) were managed by fibular fixation. Out of the 3 patients who were managed without fibular fixation 2 patients had fibula fracture at proximal third level and 1 patient had both bone leg fracture at distal 1/4th level who developed valgus malunion.

Minimally invasive plate osteosynthesis (MIPO) was used in 17.64% patients. Minimally invasive plate osteosynthesis has certain advantages. It reduces soft tissue dissection as the dissection is limited to subcutaneous tissue caused by plate during introduction. It preserves bone vascularity as the periosteum is not stripped off and plate is placed over the periosteum. It also leaves the fracture haematoma at place to stimulate callus formation. Also as compared to intramedullary nailing the intramedullary blood flow is not disturbed. These benefits were noted by many authors in their studies [4, 19, 24, 25]. However, there are some complications with this method like injury to saphenous nerve & great saphenous vein, late infection and skin impingement [24, 26]. In our study none of the patients treated by MIPO technique developed any infection and none required hardware removal during the course of follow up.

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Distal tibia fractures are complex cases and require appropriate management so as to limit the occurence of complications. For acute closed fractures without significant insult to overlying soft tissue, we prefer a stable as well as rigid internal fixation in a single stage procedure. Limited internal fixation is preferably employed for fractures without significant comminution and easily reducible by traction or external manipulation. However, to supplement this technique a non weight bearing cast is also recommended. Fixation of fractures with conventional or locking plates should be done for comminuted fractures in order to perfectlty reduce the articular surface. One of the advantage of using locking plate is earlier permission for full weight-bearing and stronger fracture stability achieved as an internal fixator.

For fractures with significant soft tissue insult, notable soft tissue oedema or in planned delayed surgery due to other causes, we recommend a two-staged protocol similar to many other authors [16, 17, 23]. The first stage involves an approximate fracture reduction and application of an ankle spanning external fixator. The second stage is usually delayed for seven to ten days until recovery of soft tissue occurs followed by open reduction and internal fixation of fracture. External fixator should not be used as a modality for definitive fixation of fractures.

Intramedullary nailing should be limited for fixation of extraarticular closed fractures (type 43-A) as also done by other authors [3, 4]. We have done intra-medullary nailing in six out of our sample of seventeen patients (35%). All the fractures were extraarticular in nature. In four of the six patients treated by intramedullary nailing fibula was also fixed and in two patients fibula was not fixed. One of the patient without fibula fixation had fibula fracture at proximal third level and the other patient had fibula fracture at distal 1/4th level who developed valgus mal-alignment (16.6%). One patient of intramedullary group developed non-union (16.6%).

One unsettled confusion in management of comminuted fractures is whether primary bone grafting indicated or not. Primary bone grafting is definitely contraindicated if soft tissue dissection needs be done to place the graft [45]. Primary bone grafting was not done in any of our cases.

Due to the limited number of patients in our study we cannot give a comprehensive definitive treatment protocol but we suggest following treatment protocol for the management of distal tibial fracture which would help surgeons in making treatment decisions while considering other associated factors.

Similar treatment protocol have also been suggested by Rushdi I. et al in 2020 [15] for the reference of surgeon for making treatment decision.

Finally we can say that there is no single universal method of fracture fixation that is ideal for all patients with distal tibial fractures and further studies are needed to prove the effectiveness of this algorithm or to give more exhaustive definitive treatment protocol.

Conclusion

Managing the fractures of distal tibia remain a therapeutic challenge for orthopaedic surgeons. As per the literature, these fractures are often associated with a significantly higher complication rate. Based on our study, best result is obtained with primary definitive internal fixation with MIPO technique if skin condition is good. If soft tissue condition is not good, a two staged procedure with primary limb stabilization with external fixator and delayed definitive internal fixation is preferred. Complication rates is always higher and functional outcomes worse in the group managed by external fixation. We believe that external fixation be used exclusively for trauma with severe soft tissue insult as a temporary measure in a two-staged protocol. For other cases, we recommend internal fixation either by open reduction or by MIPO with early mobilisation. Future prospective randomised trials with adequate sample size and longer follow-up are needed to devise the optimal treatment protocol for the management of these injuries with greater accuracy.

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