



Original Research Article

A STUDY OF SURGICAL MANAGEMENT OF DISTAL TIBIA COMMUNATED FRACTURE TREATED BY ILIZAROV FIXATOR

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ABSTRACT

Background: There are numerous challenges in the patho-anatomy of distal tibia fractures and there are multiple treatment options for fixation of distal tibial fractures ranging from expert nail (intra medullary nailing), conventional plates, external fixators which include ring fixators and hybrid fixators each having their own advantages and disadvantages. **AIM:** To study the functional outcome following surgical management of Distal tibia comminuted fractures with Ilizarov fixators. **Objectives:** 1. To evaluate the clinical outcomes following ilizarov fixation of distal tibia comminuted fractures 2. To assess the functional status of the patients following ilizarov fixation for comminuted fractures of distal tibia 3. To identify the complications of using ilizarov fixator for management of distal tibia comminuted fractures. 4. To analyse the merits and demerits of various other fixation modalities of distal tibia fractures.

Materials and Methods: Observational study done in Department of Orthopaedics (Tertiary Health Care Centre), Gayatri Vidya Parishad Institute of Health Care and Medical Technology, Marikavalasa Visakhapatnam among 38 patients selected by convenient sampling method.

Results and Discussion: In the present study about 65% of the patients are operated within 3 to 7 days of injury. The AOFAS score in the present study had reasonably good outcome with 21% excellent outcomes, 56% good, 18% fair and 5% poor outcomes.

Conclusion: Ilizarov fixation is one of the options for distal tibia comminuted fractures especially when the distal fragment is too short to accommodate adequate number of screws, soft tissue condition is not good and in case of open fractures.

Keywords: distal tibial fractures, Ilizarov fixators, External fixators.

INTRODUCTION

Distal tibial fractures is an enigma in terms of treatment options.^[1] One of the major challenges of distal tibial fractures are increased incidence of open fractures and poor skin conditions in view of

subcutaneous location of the bone.^[2] Other challenges include smaller distal fragment, comminution of the distal fragment which precludes the placement of adequate number of distal screws.

There are numerous challenges in the Patho-anatomy of distal tibia fractures and there are multiple

treatment options for fixation of distal tibial fractures ranging from expert nail (intra medullary nailing), conventional plates, distal tibia LCP, external fixators which include ring fixators and hybrid fixators each having their own advantages and disadvantages.^[3]

However, there is no exact consensus for the management of these fractures which range from purely extra-articular fractures to fractures involving the tibial pilon and from simple fracture to comminuted fracture. Adding to the above variations, skin condition, open wounds further complicate the decision making.

In spite of numerous surgical options and better surgical techniques, the outcomes are not always satisfactory. The complication rate is also high affecting 20%-50% of the patients treated.^[1] Nails and plates do not have purchase in the distal fragment if it is either too small or comminuted. Plates lead to wound dehiscence and hardware prominence. External fixators lead to pin tract infections, loss of reductions and their role as definitive treatment is also debatable

In this scenario more and more studies are needed, each exploring different treatment modalities of fixation. The present study aims to evaluate the clinical and functional outcome following the fixation of comminuted distal tibia fractures using Ilizarov.

Aim: To study the functional outcome following surgical management of Distal tibia comminuted fractures with Ilizarov fixators.

Objectives

1. To evaluate the clinical outcomes following ilizarov fixation of distal tibia comminuted fractures
2. To assess the functional status of the patients following ilizarov fixation for comminuted fractures of distal tibia
3. To identify the complications of using ilizarov fixator for management of distal tibia comminuted fractures.
4. To analyse the merits and demerits of various other fixation modalities of distal tibia fractures

MATERIALS AND METHODS

Study Design: Observational study

Study Setting: Department Of Orthopaedics (Tertiary Health Care Centre), Gayatri Vidya Parishad Institute of Health Care and Medical Technology, Marikavalasa Visakhapatnam.

Duration of Study: 6months

Inclusion Criteria

1. Patients with age group of 20-70years.
2. Distal tibia fractures articular or extra articular with very short distal fragment
3. Poor soft tissue or skin condition
4. Comminuted fracture

Exclusion Criteria

1. Pathological fractures
2. Bilateral fractures
3. Pre-existing deformity of ipsilateral limb

Sample Size: 38

Sampling Method: Convenient sampling method

Methodology

The study recruits the patients who fulfilled the inclusion criteria after getting necessary consent from the patient for surgery as well as for study participation. All patients are clinically assessed and thoroughly examined pre-operatively. Investigations which include radiographs of the afflicted limb are taken. Pre-anesthetic check-up is done. Two pairs of olive wires are passed in criss- cross fashion on either side of the fracture and four half rings are connected. Connecting rods link proximal and distal rings. The ilizarov wires are tensioned following alignment and reduction verification. Appropriate dressings are performed depending on the injury. Using radiographs, all the patients are assessed serially starting from POD-1, 6 weeks and 3 months after surgery. Johner and Wruhs criteria⁴ are used to evaluate functional outcome. Below are images showing the technique and before and post-op radiographs.

Ethical Clearance: Permission was taken from institutional ethics committee. Informed consent was taken from the participants.

Statistical Analysis: Data were presented as mean \pm standard deviation and descriptive statistics.

RESULTS

Out of 38 patients participated in the study, with age ranging from 21 to 70 years, the most common age groups were 21–30 years and 51–60 years, each comprising 10 patients. The mean age was 45.89 +16.32 years, indicating a wide age variation among the study population. Among 38 patients, 23 (60.53%) were male and 15 (39.47%) were female, indicating a male predominance in the study group. Among the patients, 10 (26.3%) were smokers, while the majority, 28 (73.7%), were non-smokers. This indicates that smoking was relatively uncommon in this cohort.

Regarding alcohol use, 10 patients reported regular alcohol intake, 16 were occasional consumers, and 12 were non-alcoholic. This shows that about 68% of the patients consumed alcohol to some extent.

Table-1 enumerates the characteristics of the fracture and co-morbidities of patients. Table-2 illustrates the post-operative outcomes like union times, AOFAS score and functional outcome as per Johner and Wruh's criteria and duration between injury and surgery.

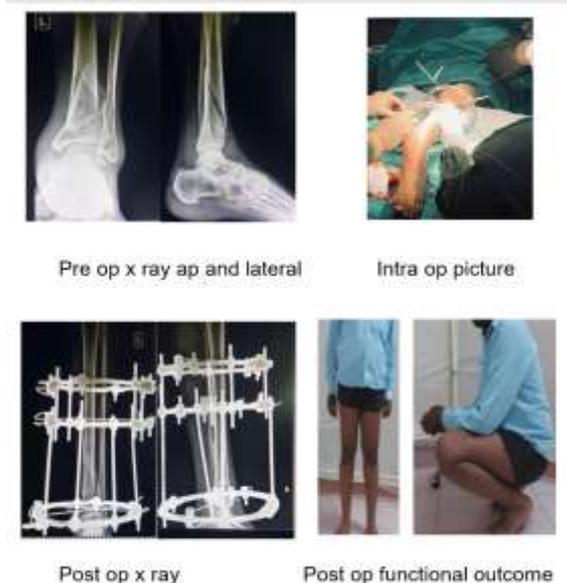
The Fig-2 shows an illustration of pre-operative and post-operative radiographs and intra-op images of a patient along with the functional outcome.

Table 1: Frequency distribution of injury related information

S.no.	Type of variable	Sub category	n	%
1.	Mode of injury	Fall from height	16	
		Road traffic accident	22	
2.	Fracture classification	43 A(Extra articular)	21	55%
		43 B(partial articular)	4	11%
		43 C(complete articular)	13	34%
3.	Type of fracture	Open	16	42%
		Closed	22	58%
4.	Open Fractures Grading As Per Gustilo Andreson Clasification ⁵	Grade-I	3	7.9%
		Grade-II	11	28.94%
		Grade-IIIA	1	2.6%
		Grade-IIIB	1	2.6%
5.	Closed Fractures Grading As Per Tscheme Classification ⁶	Grade-0	6	15.78
		Grade-1	7	18.42
		Grade-2	6	15.78
		Grade-3	3	7.89
6.	Side got effected	Right	17	44.7%
		Left	21	55.3%
7.	Associated injuries	Distal Radius	2	
		Patella	1	
		Clavical	1	
		Metatarsal	3	
8.	Comorbidities	History of diabetes	11	
		History of hypertension	15	
		No significant history	12	

Table 2: Frequency distribution of surgery and its outcome

S.no.	Type of variable	Sub category	n	%
1.	Duration between injury and surgery	Within 3 days	10	26%
		3 to 7 days	25	66%
		More than 7 days	3	8%
2.	Duration of surgery	Less than 1 hour	9	24%
		1 hour to 2 hours	19	50%
		More than 2 hours	10	26%
3.	Union time	Less than 3 months	12	24%
		3 to 6 months	20	58%
		More than 6 months	6	18%
4.	Functional Outcomes Johner and Wruhs Criteria ⁴	Excellent	6	16%
		Good	21	55
		Fair	8	21
		Poor	3	8
5.	Aofas Hind Foot And Ankle Score	Excellent(90-100)	7	21%
		Good(80-89)	22	56%
		Fair(70-79)	7	18%
		Poor(<69)	2	5%

**Figure 1: Showing Various Complications Post Surgery****Figure 2: Clinical case illustration**

DISCUSSION

Distal tibial fractures majority of times pose a challenge both to the surgeon as well as the patient in terms of outcomes because of following factors 1. Limited soft tissue around the bone 2. Precarious blood supply 3. Increased chances of compartment syndrome 3. Increased comminution especially in case of high energy trauma. 4 Intra-articular extension leads to ankle arthritis and stiffness

Main goal of the management of fractures of distal tibia is to restore the anatomy and achieve articular congruity along with maintaining or restoring the surrounding soft tissue integrity.

There are various treatment options for this distal tibia fractures ranging from open reduction and internal fixation with plating, interlocking nail, screws. Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) to external fixation using external fixators, ring fixators and hybrid fixation techniques. Each of the treatment modalities have their own merits and demerits. The study evaluated the functional outcome following fixation of distal tibia fractures with Ilizarov technique.

Fractures of distal tibia are result of high energy trauma following road traffic accidents(RTA), industrial trauma and fall from heights. The mode of injury in the present study is fall from height and RTA with the later contributing to almost 58% of the distal tibia fractures. The findings of the present study are similar to that of Kumar et al,^[5] where RTA is major mode of injury.

The soft tissue envelop around the distal tibia is very sparse increasing the risk of open fractures in distal tibial fractures. Open injuries in the present study account for about 42% of the total cases. Open injuries constitute 28.57% in the study by Kumar et al.^[5] Majority of the open fractures are of Gustilo Anderson type II.

Closed fractures are also classified as per Tscherene classification⁶ in the present study as skin status is one factor which precludes early ORIF and plating even though the fracture is closed.

Left limb is most commonly affected in the present study contributing about 55.3% of the cases. 33% of the fractures are left sided in the study by Rushikesh Abhayankar et al,^[7] contrary to the findings of the present study.

AO/OTA classification:

In the present study AO/OTA classification of distal tibia are used in which are classified in to A,B and C which are extraarticular(55%) partial articular (11%) completely intra articular (34%). The studies by Kumar et al and Kundu et al had more no. of extra articular fractures with 60% and 80% respectively.^[5,8]

Duration of surgery

Duration of surgery is about 1-2 hours in about 50% of cases in the present study. The duration of surgery in the present study is consistent with the studies of Kumar et al and Telmo Ramos et al. the average

operative time is about 82 minutes in the study by Kumar et al,^[5] (range 65-125 minutes). However the duration of surgery extended beyond 2 hours in intra articular fractures in the study by Telmo ramos et al (rang 72-314 minutes).^[4,9]

Duration Between Injury and Surgery

In the present study about 65% of the patients are operated with in 3 to 7 days of injury. However in the study by Kundu et al,^[8] this interval is around 12 days and was around 9 days in the study by Vasileos et al. In study by Kumar et al,^[5] the injury surgery interval is around 10 days. However in the study by Telmo Ramos et al⁹ majority of patients underwent surgery within 2 days.

Union time

Distal tibia fractures are prone to nonunion and delayed union. The average union time is around 17.2 weeks that is between 3-6 months. In this study absence of tenderness at the fracture site is clinical criteria for union and continuity of more than 3 cortices in Anteroposterior (AP view) and lateral views of the affected limb is considered as radiological union. In the present study about 58% of the fractures got united in within 3 to 6 months radiologically.

In the study done by Vasileos et al,^[10] about 98% of fractures got united within 23.7 weeks (range14.8 to 76 weeks) of them 62% of the fractures united by 6 months, 89% by 9 months and 96% by one year. In the study by Adil et al,^[11] the average union time was approximately 18 weeks in the group treated by Ilizarov alone and it was 15 weeks in the group treated with Ilizarov and minimal internal fixation.

The outcomes of the present study are comparable with that of Vasileos et al,^[10] where the average union time of open fractures was longer than closed. Open fractures took about 26.4 weeks which is much higher than the average union time. In the present study open fractures took about 21.8 weeks compared to 13.5 weeks in case of closed fractures for union.

Likewise, intra articular fractures needed about 26.14 weeks to unite compared to extra articular fractures which needed only 20.5 weeks to unite. The above results found in the study by Vasileos et al¹⁰ are similar to that of the present study where the average union time for intra and extra articular fractures is around 17.6 weeks and 16.9 weeks respectively.

Other factors which might affect the fracture union are habits of smoking, presence of co-morbidities like diabetes mellitus. Though the association is not statistically significant, it is observed in the present study that the average time of fracture union in case of smokers and alcoholics is around 17.3 weeks, compared to that of 16.8 weeks in case of non-smokers and non-alcoholics. The average union time is around 17.3 weeks in case of patients with diabetes mellitus compared to 15.5 weeks among those without any co-morbidities.

MEASUREMENT OF FUNCTIONAL OUTCOME

AOFAS SCORE: The AOFAS score contains 3 sub scales, which include, pain, function and alignment.

The AOFAS score in the present study had reasonably good outcome with 21% excellent outcomes, 56% good, 18% fair and 5% poor outcomes. The results of the present study are better than the study done by Elgammal et al,^[12] where there are 40% excellent results, 26.67% good results, 20% good results and 13.67% poor results. It can be observed from the study by Elgammal et al,^[12] the highest AOFAS score was 95.40 both in extra-articular as well as intra-articular fractures. The least score being 61.34 in intra-articular fracture and

88 in the extra-articular group. However, in the present study the highest score is similar to that of Elgammal et al,^[12] with 94 and least score is inferior than that of the former with 71. In intra-articular fractures, the best score is around 93 and worst score is 48. The patient with inferior AOFAS score is found to be a diabetic, smoker and is non-compliant with physiotherapy protocol, leading to stiffness of the joint as well as delayed fracture healing. The table-3 given below gives a glimpse of outcomes among different studies.

Table 3: Comparison of clinical outcomes among different studies
Range of motion(ROM):

Outcomes	Abhayankar R et al(MIPPO) ⁷	Kundu et al (MIPPO) ⁵	Kumar et al (Distal tibia LCP) ⁸	Present study (ILIZAROV)
Excellent	20%	60%	50%	21%
Good	60%	20%	32.14%	56%
Fair	20%	20%	17.86%	18%
Poor	0	0	0	5%

Range of motion of ankle and knee also form an important part of assessment of functional outcome Study by Elgammal et al,^[12] showed about 53.3% of the patients had near normal ROM, 33.33% had moderate restriction while 13.33% had severe restriction of movements. The observations of the present study are consistent with that of Elgammal et al,^[12] with 62% retaining near normal ROM, 20% moderate ROM and 12% severe restriction of ROM. Study by Ramo's et al⁹ reported reduction in ROM of about 10 degrees compared to contralateral side in their study.

Distal tibia is a bone with sparse soft tissue cover and precarious blood supply predisposing it to more complications. One of the frequently encountered complication in external fixators is pin tract infection or pin site infection. Study by Parameswaran et al,^[13] shows that incidence of pin site infections are more common in external fixators compared to Ilizarov fixators. However, majority of them are minor infections which respond to oral antibiotics. Most common complications found in the present study is delayed wound healing 18.42% followed by pin site and pin tract infection of 15.78%.

Johner's and Wruhs Criteria

To measure the outcome after treatment of distal tibia with Ilizarov, Johner's and Wruhs criteria was used in the present study. There are 2 cases of non-unions which ended up in poor outcome as per the criteria and one case with severe varus deformity of more than 10 degrees varus also had poor outcome. There are two cases of mild varus deformity, 2 cases of shortening which led to limp and 4 cases of stiffness of ankle joint which reported fair outcome. Rest of them had good to excellent outcomes. None of them had restriction of activities.

Limitations of the study

1. Limited sample size, precludes application of results to larger population

2. This is a study done at a single center. Multicentric studies increase the strength of the study.

CONCLUSION

Distal tibia fractures that too with involvement of articular surface, comminution pose a challenge in treatment point of view. There are wide variety of treatment options ranging from intramedullary nail for an extra articular fracture to ring fixators.

External fixators like Ilizarov fixators are one option especially when the distal fragment is too short to accommodate adequate number of screws, soft tissue condition is not good, in case of open fractures. But their role as definitive fixation options is precluded by higher incidences of pin tract infections, loss of reduction and malunion. However, their versatility is a great advantage. MIPPO confers more patient compliance and increased stability of fixation. However, complications like hardware prominence and wound dehiscence are encountered especially if skin condition is compromised. Both the choices of fixation have their own merits and demerits. Case selection is important for achieving optimum outcomes with each of the fixation techniques.

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