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Original Research Paper

Orthopaedics

FUNCTIONAL OUTCOME OF DISTAL TIBIA FRACTURES MANAGED WITH HYBRID RING FIXATOR

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ABSTRACT

Introduction : distal tibia fractures are amongst the common open fractures encountered in day to day life owing to high energy trauma , the challenge to achieve union is added on due to absence of soft tissue envelope surrounding the bone apart from biological low blood supply

Material and methods: this study was done in SRG Hospital and medical college , Jhalawar Rajasthan , comprising of 25 patients with open extra articular distal tibia fractures. Treated by reduction and external fixation with ring hybrid fixator.

Results: The results were based on the objective and subjective parameters as described by Ovadia DN and Beals RK , we had 14 (56%) patients with excellent, 5 (20%) patient with good, 5 (20%) patients with fair and 1 (4%) patient with a poor outcome.

KEYWORDS : distal tibia , hybrid ring fixator

INTRODUCTION

Distal tibial fractures represent a significant challenge to most of the surgeons even today[1]. They are about 1-10% of all lower extremity fractures.[2] The low energy type of fractures often get dramatic results with open reduction and internal fixation. But high energy fractures are documented to show a high amount of complications due to soft tissue coverage, skin necrosis, infections and also the usually comminuted nature of the fractures.[3]

Conservative treatment by cast application lead to prolonged immobilization, leading to ankle and knee stiffness affecting quality of life of the patient.[4]

The Hybrid External Fixator combines the advantages of the monolateral pin fixators and the circular Ilizarov wire fixators. The tensioned wires provide improved fixation in the small distal cancellous fragment, whereas the pin fixators give adequate stability to the proximal fragment. It is simple, has a rapid and straight forward application, reduced surgical time and is minimally invasive. It is adjustable, hence fracture reduction can be easily attained after frame assembly.[5] Along with rigid fixation,

and it allows immediate mobilization of the knee and ankle joints and early weight bearing. "Early motion has been touted as the functional savior of major intra articular injuries".[6]

MATERIALS AND METHOD

A prospective study was conducted in SRG Hospital & Jhalawar medical college. The Study included a series of twenty-five patients with distal tibial fractures. All patients were explained clearly about the study and an informed consent is obtained from each of them.

Inclusion Criteria

- Patients in the age group of above 18 years to 80 years
- Open Distal tibial fractures involving distal 5cm of tibia AO type A, B and C

Management of Open Fractures:

Patients with open fractures were graded using the Gustilo Anderson classification for open fractures. Antibiotics were started immediately for all patients. Injection Tetglob (Tetanus immunoglobulin) 500 IU IM and single dose of tetanus toxoid was given.

The limb was initially immobilized in an above knee Plaster of Paris slab till definite fixation was done.

Operative Procedure:

Type of Anesthesia- Lumbar Sub Arachnoid Block (Spinal)

- Position-supine with affected leg elevated on a pillow/sand bag.

Securing the distal fragment:

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- After reduction of the distal fragment, it was secured using three olive wires.
- The wires were pushed manually till it hit the cortex, then drilled across both the cortices and hammered out through the opposite soft tissue.
- Two olive wires were placed at 40-70^0 to each other, one from posterolateral to anteromedial and posteromedial to anterolateral under fluoroscopic control.
- Minimal incisions were used to accommodate the beads in the olive wires.
- A third plain wire was placed in between the earlier two wires, parallel to the operating table.
- Appropriate size Ilizarov half ring was selected, so as to leave a gap of 2 cms between the leg and the ring on all sides.
- The wires were fixed to the rings using cannulated/slotted wire connecting bolts and tensioned.

Securing the proximal fragment:

- Three 4.5mm Shanz pins were placed 3-4cms apart on the antero-medial surface of tibia perpendicular to the operating table.
- Generous (1.0-1.5cms) incisions were put and skin and fascia was cut.
- Drill holes were made using 3.2/3.5mm drill bit in the same saggital plane.
- The Shanz pins were driven into the drill hole using a T-

Handle to the extend that the proximal end of the threads of the pin were well buried in the proximal cortex.
- All the pins were placed in the same saggital plane.
- The pins were connected to the connecting rods with the pin clamps.

Fracture reduction and frame assembly:
- Fracture reduction was obtained using longitudinal traction (Ligamentotaxis), confirmed using the image intensifier.
- The pin fixator assembly was connected to the ring assembly using a twisted connecting plate.
- All the nuts and bolts were tightened.
- A diagonal strut was connected from the proximal Shanz pin or the connecting rod to the lateral most hole of the half ring for extra stability.
- The compound fractures were treated with primary or secondary flap reconstructions or split thickness skin grafting as deemed suitable by the plastic surgeon.

Post operative regimen:
Active mobilization of the ankle, knee and non-weight bearing of the patient using standard walking frame was done from the first post operative day.

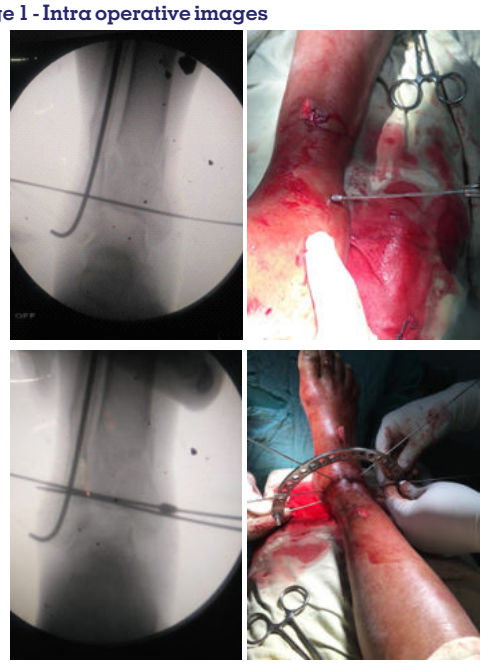
Intravenous antibiotic regimen was continued for 5-7 days after the surgery. Another 5 days of oral antibiotics were advised. Regular cleansing of the pin exit points were done.

Follow up:
The patients were followed up at intervals of three weeks for up to 6 months to assess the radiological union and to check the stability of the construct.

Partial and full weight bearing were allowed based on the radiological union and consolidation of the fractures. Uncomplicated fixators were removed after complete fracture union. Fixators with pin tract infections were removed earlier and a patellar tendon bearing cast was applied which were removed after radiological union of the fracture.

Ovadia and Beals[10] based results on objective and subjective evaluation. This scoring system was used in this study to assess the results.

Image 1 - Intra operative images



OBSERVATION AND RESULTS

The present study consists of 25 cases of fracture of the distal metaphyseal end of tibia. All the cases were fixed using the hybrid external fixator. The study period was from July 2018 to June 2019

Duration (in weeks)	No. of Patients	Percentage
12	10	40
13	7	28
14	6	24
15	2	8
Total	25	100

Duration of fracture union: Table 1

Duration (in weeks)	No. of Patients	Percentage
10	2	8
11	1	4
12	8	32
13	7	28
14	7	28

Removal of fixator: Table 2

Results:
The results were based on the objective and subjective parameters as described by Ovadia DN and Beals RK. [7]

Rating	Ankle/ subtalar Motion	Tibio talar align ment	Tibial shorte ning	Chronic swelling	Pronation/ supination	Equines deformity
Excell ent	> 75% normal	Norm al	None	None	Normal	None
Good	50-75%	Norm al	None	Minim al	Normal	None
Fair	25-50%	$<5^0$ angu lation	< 1cm	Moder ate	Moderate decrease	None
Poor	< 25%	$>5^0$ angu lation	> 1cm	Severe	Marked decrease	Present

Objective criteria: Table 3

Rating	Pain	Return to work	Recreational activity	Limited walking	Pain medication	Limp
Excell ent	None	Same work	Normal	No	None	None
Good	Mild	Same work	Mild modification	No	None	None
Fair	Mod erate	Modifi ed	Significant modification	Yes	Non narcotic	occas ional
Poor	Seve re	Unable	None	Yes	Narcotic	Yes

Subjective criteria: Table 4

COMPLICATIONS:

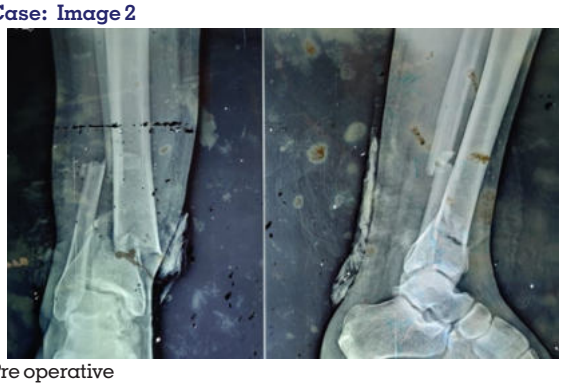
1. Pin tract infections:
Four of the patients developed superficial pin tract infections, which were treated with daily dressings and appropriate antibiotics after pus culture and sensitivity. All these infections subsided on the above said treatment. However, as a precautionary measure, the fixators were removed earlier (10-12) weeks and a patellar tendon bearing cast was applied in these patients, which were removed after radiological union of the fracture.

2. Ankle stiffness:
We had 10 patients with ankle stiffness. This was probably due to the incompliance of the patient to the advised physiotherapy regimen, as there was no means to monitor the physiotherapy of the ankle joint after discharge of the patient. Ankle stiffness ranged from restriction of ankle movement from 20%-90%.

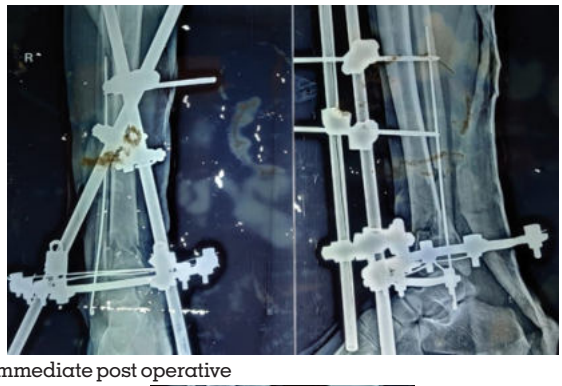
The patient who had 90% restriction had an equinus deformity.

3. Anterior angulations:
Two patients developed an anterior angulation of 5^0. This however did not grossly hinder with the mobility of the joints or daily activities of the patients.

Case: Image 2



Pre operative



Immediate post operative

After fixator removal

Follow up at 6 months

DISCUSSION

The goal of operative treatment is to obtain anatomic realignment of the joint surface while providing enough stability to allow early motion. This should be accomplished using techniques that minimize osseous and soft tissue devascularization in the hopes of decreasing the complications resulting from treatment.

The present study was under taken to determine the efficacy of the Hybrid External Fixator in treatment of the fractures of the distal tibial metaphysis.

We evaluated our results and compared them with those obtained by various other studies utilizing different modalities of treatment, our analysis is as follows:

Duration of fracture union:
The average time for fracture union in various studies conducted using various methods was 13-16 weeks. Our study had an average fracture union of 13 weeks which were comparable with studies conducted using the hybrid external fixator. Barbieri et al[8] had an average fracture union of 14 weeks and Gaudinez et al[9] had an average of 13 weeks.

Removal of fixation:
In our study, we had removed the fixator at an average of 12.64 weeks. It is however lower than the 14.5 weeks in a similar study by Gaudinez et al[10], probably due to the fact that fixators with pin tract infections were removed earlier (10-12 weeks) and PTB cast was applied for 2-3 weeks. Barring the 4 patients with pin tract infection, the average fixator removal time was 13 weeks, which is comparable to the similar study.

Results and Complications:
In a study that established open reduction with plate and screw fixation as the standard. Ruedi and Allgower[11] achieved 74% acceptable results in 84 patients. These results did not deteriorate for 9 years. Bourne and colleagues[12] studied 42 patients with tibial plafond fractures, 62% of whom were victims of high-energy trauma. Of the 16 Ruedi type III fractures treated by open reduction and internal fixation, only 44% had a satisfactory result. The majority of these fractures were complicated by nonunion (25%),

infection (13%), and Arthrodesis (32%). Teeny and Wiss[13] studied 60 tibial plafond fractures. 60% of those were secondary to high-energy trauma. They reported 50% poor results when open reduction and plate fixation was used. When the subset of 30 Ruedi Type III fractures was analyzed there were 12(40%) acceptable outcomes with 37% of these fractures complicated by a skin slough or deep infection. Mc Ferran et al [14] reported on 52 tibial plafond fractures treated with open reduction and internal fixation. Forty percent of these were Ruedi Type III injuries. Overall, 40% of the patients suffered some complication, with a deep infection or osteomyelitis occurring in 43% of fractures, and a wound breakdown requiring soft tissue coverage in 62% of fractures.

Bone et al[15] reported on a series of 20 high-energy tibial plafond fractures treated using limited open reduction and internal fixation of the articular surface followed by neutralization of the fracture with an external fixator placed across the ankle joint. All the fractures healed, and only 2 patients (10%) had a poor clinical result. There were minimal complications with 2 pin tract infections (20%), no deep infections, and no skin sloughs occurring.

Bonar and Marsh[16] reported on use of hinged transarticular external fixator to treat pilon fractures. Post operative complications were minimal with no cases of superficial or deep wound dehiscence. There were 5 cases of pin tract infection. Two required oral antibiotics, two required intravenous antibiotics, one required external fixator removal and subsequent deformity. There was no late surgery or osteomyelitis. The results were described as good in 69%, fair

in 20% and poor in 11%.

Using the technique of hybrid external fixator, Tornetta et al[17], accomplished 69% good results in the high energy injuries and major complications were avoided. There was one deep infection, one superficial infection, one malunion and three pin tract infections. Barbieri et al[18] achieved 67% good results using the hybrid external fixator. There were three cases of osteomyelitis, one skin sloughing and five pin tract infections. Three patients had a loss of reduction and required frame revision. Gaudinez et al[19] based their study on the scale by Ovadia and Beals[7] with 64% patients having good to excellent subjective results, and 71% patients had Good to excellent objective results. Complications included superficial pin tract infections in 3 patients, all of which resolved with local pin care and a short course of orally administered antibiotics. There were no deep infections.

It is extremely difficult to make true comparisons between these studies because the method of fracture classification, number of high energy injuries, and functional scoring system all differ. However, when critically analyzing the outcomes of this study with respect to earlier studies, the comparison is favorable.

In our study, we had 14 (56%) patients with excellent, 5 (20%) patient with good, 5 (20%) patients with fair and 1 (4%) patient with a poor outcome.. The 76% good to excellent result is better than or equal to most of the series.

CONCLUSION

According to the study, 25 patients with fractures of the distal tibial had undergone closed reduction and application of the hybrid external fixator. This technique has resulted in the effective stabilization of these fractures. It does provide adequate stability and allows early motion. The closed reduction not only helps in achieving reduction in difficult situations, but also in rapid union, because it facilitates preservation of the blood supply to the fragment. This method limits further damage to the already compromised soft tissue. Its greatest advantage is in open fractures where wounds can be left open. It is also effective in extraarticular fractures occurring within 5cm of the joint because, Intramedullary nails often do not provide enough stability and plates would require extensive soft tissue dissection.

It is a simple, has a rapid and straight forward application and has a reduced surgical time. Tensioned wires provided improved fixation in small and osteoporotic fragments.

When encountered with the unreconstructable distal tibial fracture, those with comminution or poor bone stock, rather than a primary Arthrodesis, closed reduction and Hybrid External Fixator satisfies the goals of plantigrade foot and soft tissue healing, without obviating any other means of further treatment.

Although, a larger sample of patients and longer follow up are required to fully evaluate this method of treatment, we strongly encourage its consideration in the treatment of such complex fractures.

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