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Case Series

Functional and radiological outcome in distal both bones fractures leg treated with hybrid external fixators

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Abstract

Management of distal both bones fractures remain a challenge due to the therapeutic dilemma whether to give importance to the articular congruity, anatomical reduction, or soft tissue healing. The main aim of this study is to evaluate the effectiveness of hybrid external fixator as a definitive treatment of distal both bones fracture.

In our study 15 distal both bone fractures both closed and compound treated with hybrid external fixator was followed for 1 year. All distal both bone fractures had a good union except one and the healing average time to healing of 21 weeks. The Common complications seen were malunions, pin tract infections and delayed union. According to ovadia and beals scoring system, 33.3% had excellent results, 40% had good results, 12.3% fair results and 12.3% had poor results. Hybrid external fixator provides definitive management for distal both bone fractures leg with minimal complications. Hybrid External Fixator helps us to have proper access to wound care in case of open distal both bone fractures.

Keywords: Hybrid external fixator, Distal both bones, Open fracture.

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1. Introduction

The treatment of distal both bones fractures remain a therapeutic dilemma, whether to give importance to the articular congruity, anatomical reduction, or soft tissue healing. Distal both bone fractures are usually high energy injuries with extensive soft tissue damage. Decreased vascularity, poor soft tissue coverage poses a serious threat of delayed union, malunion, non-union and complications related to wound in these fractures.[1] The most efficient method of managing these fractures is by anatomic reduction of articular surface, restoration of bone alignment and early ankle mobilization. Different modalities of treatment of distal both bone fractures are open reduction and internal fixation, initial spanning external fixator followed by internal fixation, hybrid external fixator and ilizarov fixator. The prime goal of treatment should provide adequate soft tissue management to avoid infection and wound related complications.

2. Materials and Methods

This study was conducted at Institute of Orthopaedics and Traumatology, Coimbatore medical college hospital over a period of 1 year from February 2023 to February 2024. A total of 15 patients with distal both bone fracture, both closed and compound fractures were included in study. All patients underwent routine radiological investigation including CT ankle before proceeding with surgery. Compound fractures were treated within 6 hours of admission in emergency operation theatre with wound debridement, Adequate wound wash and skeletal stabilisation was done with hybrid external fixator. All surgeries were performed under spinal anaesthesia under strict aseptic precautions with antibiotic coverage.

2.1. Inclusive criteria

Age more than 18 years. - Individual without psychiatric illness–distal both bones fractures both closed and compound

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fractures distal 5cm of tibia. - Both Intra and extra articular fracture were included.

2.2. Exclusive criteria

Age less than 18 years. - Patients with psychiatric illness. - Poly trauma patients associated with other fractures. - More than 2 weeks old fracture. During surgery articular surface is reduced to near normal and held in position and Aliza and olive wire were inserted parallel to join line about 20mm from joint line. First wire is passed from lateral to medial parallel to joint line, second wire is passed from posterolateral to anteromedial and third wire is passed from posteromedial to anterolateral with wires forming an angle of more than 60 degree between them. These three wires in the distal fracture fragment were found to be satisfactory for all types of fractures encountered including intraarticular fractures. Wires are connected to 3/4th and half rings and wires are tensioned using tensioner. 3 schanz pin were inserted in tibia proximal to fracture site connected to AO rod, rings connected to AO rod using clamps and tightened. Stability of frame was increased by connecting additional one or two AO rod to ilizarov ring and clamps tightened, no cases of construct failure was encountered during this study. Knee mobilisation and ankle mobilization were started at second post-operative day. Patients were kept in non-weight bearing for 6 weeks and later assisted mobilisation was started. Patients were regularly followed up at 2 weeks, 6 weeks,3-month, 6 month and 1 year and serial radiograph (**Figure 6**-**Figure 10**) and Ovadia and Beals scoring scale was calculated at 3 months, 6 month and 1 year. Hybrid external fixator was removed once signs of union was seen on radiographs. Ovadia and Beals scoring scale. (**Figure 1**). Ovadia and Beals scoring scale used to assess the functional outcome. (**Figure 2**).

S.no	Parameter	Excellent	Good	Fair	Poor
1	**ROM**	>75 %	50 -75%	25-50%	<25%
2	**T-T alignment**	In axis	In axis	<5*	>5*
3	**Tibial shortening**	Absent	Absent	<1cm	>1cm
4	**Chronic edema**	Absent	Slight	Moderate	Severe
5	**Pronation supination**	Normal	Normal	Slightly reduced	Very reduced
6	**Fixed deformities**	Absent	Absent	Absent	Present

Figure 1:

S.no	Parameter	Excellent	Good	Fair	Poor
1	**Pain**	Absent	Slight	Moderate	Severe
2	**Return to work**	Same job	Same job	Different job	Impossible
3	**Recreational activity**	Unchanged	Slightly changed	Greatly changed	Impossible
4	**Limitations to walking**	Absent	Absent	Present	Present
5	**Analgesics**	Not Necessary	Not necessary	Necessary	Opiates
6	**Limping**	Absent	Absent	Occasional	Present

Figure 2:

3. Results and Observations

All 15 Patients were followed up for period of 1 year. Radiological union and functional outcome were evaluated using Ovadia and Beals scoring scale at 3 month, 6 month and 1 year. Out of 15 patients 6 patients sustained closed fracture and 9 had compound injury. Fracture pattern was identified before fixation, 6 patients had extra articular fracture and 9 patients had intraarticular fracture pattern involving articular surface. Bony union was evaluated by signs of bridging callus seen on radiograph. Average time for bony union was at 21 weeks ranging from 15 weeks to 30 weeks. At 1 year follow up functional outcome was excellent in patients which is 33.3%, good in 6 patients 40%, fair in 2 patient 13.3%, 2 patients with poor outcome about 13.3% (**Table 1**). Pin site infection was seen in 6 patients was treated with oral antibiotics and proper pin site care which was resolved following treatment.

Table 1: Comparison of time taken for union

Study	Time to union in weeks
Barberi et al.[4]	16
Tornetta et al.[10]	17
Anglen et al.[1]	20
Guandinez et al.[7]	13
Mayil Natarajan et al.[12]	28
Present study	21

Table 2: Comparision of results based on ovadia and beals criteria

Study	Excellent	Good	Fair	Poor
Zeman et al[11]	26%	32%	26%	16%
Aggarwal et al[6]	26	50	14%	10%
Mayil Natarajan et al[12]	50%	20%	15%	15%
Present study	33.3%	40%	13.3%	13.3%

Table 3: Age comparison

Age in years	Patients	Percentage
21-30	01	06.6%
31-40	03	20%
41-50	06	40%
51-60	05	33.3%

Table 4: Gustilo Anderson classification

Gustilo & Anderson classification	Patients	Percentage amongst open fractures
Type I	05	55.5%
Type II	03	33.3%
Type III	01	11.1%

Table 5: Complications

Complication	Patient	Percentage
Pin tract infection	6	40%
Malunion	1	06.6%
Nonunion	0	0%
Delayed union	2	13.3%

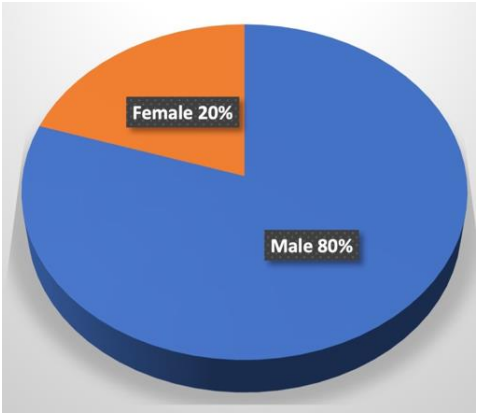

Figure 3: Sex comparsion

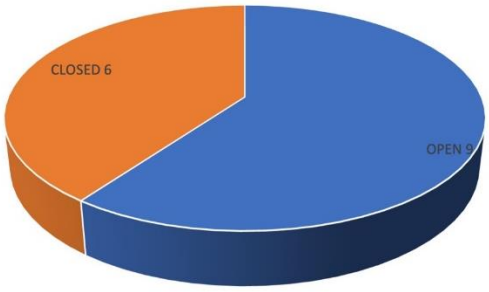

Figure 4: Type of injury

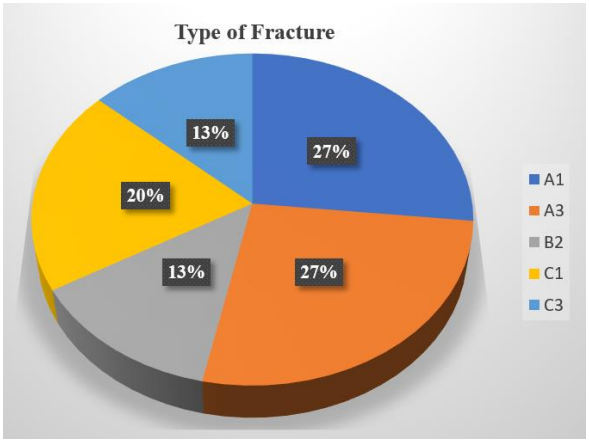

Figure 5: AO type of fracture

Figure 6: Pre-operative x-rays

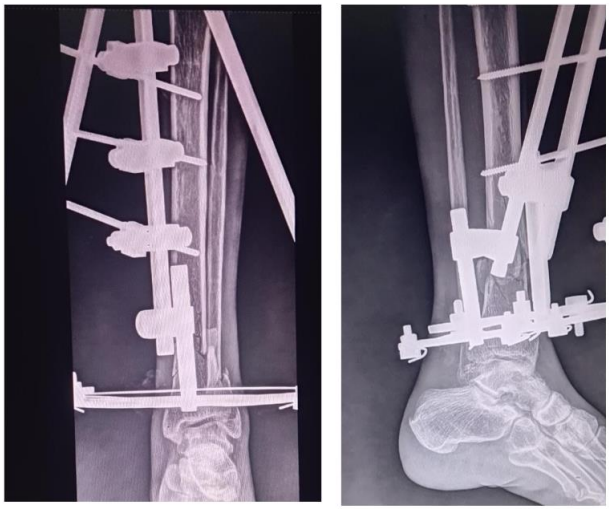

Figure 7: Post-operative x-rays

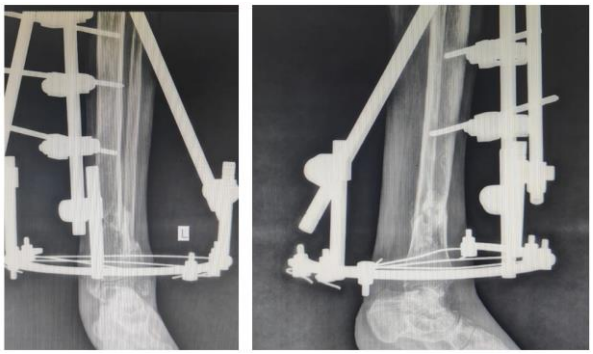

Figure 8: Follow up x-rays

Figure 9: Post removal x-rays

Figure 10: Post-operative clinical images

4. Discussion

One of the hardest fractures to treat is a distal tibia fracture. The Outcome is influenced by severity of comminution, articular injury, and soft tissue injury. The goals of surgery is to provide articular congruity and stability.[2] Various techniques are used meticulously to decrease osseous devascularisation and soft tissue de-vascularization. One among best techniques to achieve this, is the hybrid external fixator modality.[3]

The goal of this current study is to evaluate the effectiveness of the hybrid external fixator in treating distal tibia fractures.

In our study the average age of patients who presented with distal both bone fracture leg was found to be 43.4 years (Range 22 to 55 years) (**Table 3**). In our study, the incidence of fracture was more among male, with the incidence of 80% (**Figure 3**). Other Studies like Barbieri et al[4] also had a male predominance with incidence of 59%. In our study more of injury was due to road traffic accident (high energy injury) contributing to 80% of distal both bone fractures leg. In the following studies except Ovadia and Beals[5] which could attribute only 46% of high energy injury; however, other studies like Agarwal et al[6] and Gaudinez et al[7] had 87% patients and 93% patients with high energy injuries. In our study 60% where open both bone fractures (**Figure 4**) and it was comparable to the study by Gaudinez et al.[7] Open fracture patients had a medium to good clinical prognosis, primarily because to delayed union time and minor ankle swelling that persisted over time. In our Study 26.6% was type A1, 26.6% were type A3, 13.3% was type B2, 20% was type C1, 13.3% was type C3 (**Table 4**, **Figure 5**) when compared to studies by Barbieri et al and kevin et al approximately the fractures were showed 9% type Al, 9% type A2, 10% type A3, 16% type C1, 32% type C2 and 24% type C3. In our study the extra articular fractures comprised a total of 53.2% patients, and they showed results that varied from good to excellent. whereas patients with Type C fractures showed fair results due to complications like chronic pain, edema and ankle stiffness. The average Time of union for fractures in our study was 21 weeks compared to various studies which had an average time of 13-25 weeks (**Table 1**). Of all the studies Barbieri et al and Guadinez et al had good results with average fracture union of 16 weeks and 13 weeks respectively. Both Type B and C fractures in our study had a longer time for union because of a metaphyseal bone deficiency that necessitates a primary bone transplant. The reason for the delay in fracture union could be because they are more complicated fractures.

In our study there were 15 distal both bone fractures leg which was managed by hybrid external fixators. All of these fractures got united with an average time period of 21 weeks. Out of these 15 cases 11 of them had good to excellent results. 2 had fair results and 2 had poor results (**Table 2**). Out of our 15 cases 6 of them had pin tract infections amounting to 40% which was due to poor pin site care. 1 had valgus malunion accounting for 6.6%. 2 cases had delayed union amounting for 13.2% (**Table 5**). The results of our study compared with various other studies, Gaudinez et al had 14 cases of distal tibia fractures managed with hybrid external fixators, in their study 8 patients had pin tract infections and 1 had varus malalignment. Barbieri et al had 37 cases. Of distal tibial fractures managed by hybrid external fixator out of these 5 cases (14%) had pin tract infections, 5 cases had post traumatic tibiotalar arthritis (15%), 3 cases (9%) had non-

union and 3 (9%) had loss of reduction which required re alignment. Bone et al[8] in his case series of distal tibia fractures managed by open reduction and internal fixation followed later by neutralization of it with an external fixator. In his study all fractures had good healing with only 2 patients (10%) with poor clinical results. His complications were also minimal with only 2 cases reported to have pin tract infections (20%). Bonar and Marsh[9] used hinged transarticular external fixator for pilon fractures. In their study 69% had good results, 20% had fair results and 11% had poor results. They also had minimal complications with 5 cases of pin tract infection. They had no wound related infections or osteomyelitis. Tornetta et al[10] used hybrid exteral fixators and had 69% good results. With 3 cases of pin tract infections and 1 case of malunion. Barbieri et al used hybrid external fixators and had 67% good results He had 5 cases of pin tract infections and 3 cases of osteomyelitis, and 3 patients had a loss of reduction and underwent frame revision. Gaudinez et al in his study had 64% patients having good to excellent results. And the study had 3 cases of pin tract infections. Zeman et al[11] in his study of periarticular fractures of the tibia treated with hybrid external fixator had 26% excellent results, 32% very good results, 26% satisfactory results and 16% poor results. Aggarwal et al[6] in his study had 86% good to excellent results, 6% had fair results and 8% had poor results. Merits of using a Hybrid fixator: The Hybrid fixator maintains length, alignment and it spans over the comminuted region. It also allows access to wound and soft tissue with has been injured. The invent of Olive wires used from opposite directions provides interfragmentary compression and helps in achieving articular congruity.

5. Conclusion

Hybrid external fixation for distal both bones fracture leg provides adequate fixation of fracture without any further soft tissue injury. It also provides access to wound care. Thus, Hybrid external fixator is an effective modality in managing the fractures distal tibial especially when there is soft tissue injury and in compound fractures.

6. Source of Funding

None.

7. Conflict of Interest

None.

8. Ethical Clearance

Ethical No.: 109/2022.

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