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Functional and Radiological evaluation of the management of distal tibia fracture with three different surgical interventions.

Dr Shubham Taori[1], Dr D S Bhamare[2], Dr Anirudh Kandari[3], Dr Abhisheck Singh Bhadauriya [4] ,Dr Anurag Anand[5] , Dr Rahul Agarwal [6]Department of Orthopaedic Dr D Y Patil Medical College Hospital & Research Centre, Dr. D. Y.Patil Vidyapeeth, Pimpri, Pune, Maharastra-411018,India

Corresponding Author: Dr Abhisheck Singh Bhadauriya[4] Orthopaedic Resident

Dr D Y Patil Medical College Hospital & Research Centre, Dr. D. Y.Patil Vidyapeeth, Pimpri, Pune, Maharastra-411018,India

ABSTRACT

Background: The study was conducted with the aim to evaluate the management of distal tibial fractures with IM nailing, external fixator and MIPO and determine which one is optimal for each individual patient.

Methods: A total of 60 patients were treated for distal tibial fracture using different modalities according to the fracture pattern and skin condition. Clinical, functional and radiological evaluation was done for each modality. Patients were assessed for complications like ankle

stiffness, wound discharge, non-union at each follow up.

Results: The mean AOFAS score was highest in the patients treated with MIPO followed by IM nailing and External Fixator and the difference was statistically significant. Most of the complications were found in the patients treated with External Fixator followed by MIPO and IM nailing. And most number of varus and valgus deformities were found in the patients treated with External Fixator and IM nailing and least in the patients treated with MIPO.

Conclusion: MIPO was a better treatment modality than IM nailing and External fixator from clinical, functional and radiological perspectives.

Key words: IM nailing, external fixator, MIPO, distal tibial fracture

INTRODUCTION

In road traffic accidents Fractures are the most prevalent type of injury. Lower extremities bones are frequently involved in car accidents. The power and speed of the automobile at the period of damage have been found to play a significant influence in these types of injuries. The tibia is the extreme frequently fractured long bone, as well as the most commonly fractured open bone. Rendering to the location of the fracture in the part of tibia bone, the distal part of tibia has the second greatest incidence.[1]

Distal tibia fractures are often due to fastly moving vehicle accidents that cause severe soft-tissue injury. Surgeons must decide whether to prioritise not soft tissue get heals or anatomical reduction and articular congruence when treating these fractures. Caused by insufficient soft tissue covering, decrease blood supply of the distal tibia area, and related soft tissue injuries, orthopaedicians have been confronted with difficulties such as abnormal healing, delayed union, fracture bone not getting united properly , and wound concerns.

Anatomical decrease in the articular area, fracture alignment restoration, proper soft tissue manipulation, and early ankle movement have all been found to be beneficial in the dealing of distal tibial fractures. Ruedi and Allgower's seminal study in 1969 [2], in which 74% of patients had good functional result after 4 years, altered the treatment procedure for distal tibia fractures. The ideologies of open reduction and internal fixation were widely used in the dealing of distal tibia fractures in the 1970s and 1980s, but it was related with a high percentage of difficulties such as abnormal healing of bone, superficial sepsis, Osteo-myelitis, arthrodesis, below knee amputation, post-accidental osteoarthritis, and fracture bone not getting united properly.[3,4]

The various treatment modalities for these types of fractures include open reduction and internal fixation, joint straddling external fixator, fusion external fixator,to apply ilizarov fixator , closed reduction and internal fixation with intra medullary nailing, and biotic minimally invasive plate osteosynthesis (MIPO). The stabilisation technique chosen must be adequate to keep the reduction in place. Therefore, the optimal treatment option for a distal tibial fracture is one that minimises soft tissue damage and devascularization of the bone remains while achieving satisfactory reduction and stability.[6-8]

The present study was conducted to evaluate several treatment options for distal tibial fractures and determine which one is optimal for each individual patient.

MATERIALS AND METHODS

This study was conducted at Dr. D.Y. Patil Medical College and Research Center, Pimpri, Pune for a period of one and half years. Informed consents from all the patients and ethical clearance from the institutional ethical committee were obtained before conducting the study. A total of 60 patients were treated for distal tibial fracture using different modalities according to the fracture pattern and skin condition.

Inclusion and exclusion criteria

Patients within the age of 18 to 65 years presenting with open and closed intra-articular and extra-articular distal tibia fracture were included in the study.

Patients with Neurovascular injuries or previous fracture around knee, ankle, foot or pre-existing deformity of concerned part were excluded.

Methodology

On admission of the patients, detailed history was taken of the patient and complete general and local examination was done. After stabilizing the patient, x-rays and CT-scan were done. All patients were selected after getting proper history, clinical examination and obtaining relevant radiographs. AO classification for distal tibia fracture was used to classify these distal tibia fractures. Follow up for an average period of one year was done for all the patients. All Cases were treated according the fracture pattern and wound condition which was graded according to the Gustilo-Anderson classification.

Immediate post-operative x-rays were performed and evaluated. Immediate radius of motion and walking without putting weight was emphasized in post-operative period based on stability of fracture reduction. Intravenous antibiotics were given till post-operative day 5 and then oral antibiotics were continued till the day of suture removal. The suture removal was done on post-operative day 12th. On discharge non-weight bearing walking with walker, ankle range of motion was advised.

After removing the suture on post-op day 12th patients were called after 2 weeks for inspection of surgical scar and to check for progression of range of motion. During second follow up at 8th week of post-op, radiograph was advised to see signs of fracture union and loss of reduction. Toe touch walking with help of walker was advised at the 8th week post op.

In Radiological assessment following criteria were assessed: malalignment, maintenance of reduction and time to bone union. Radiographs were done at follow up of 3 months to see the status of bone union and after assessing clinical and radiological signs of union. Patients were advised partial weight bearing and then full weight bearing walking after assessment of the radiograph.

Then patients were followed monthly till six months and then were followed at 12th months when the functional assessment was done using USA Orthopaedic Foot and Ankle Society Score (AOFAS). Patients were assessed for complications like ankle stiffness, wound discharge, non-union at each follow up.

Statistical analysis

The data was tabulated in Microsoft excel and analysed with SPSS V.24 software. The continuous variables were presented with mean and standard deviation. The categorical variables were presented with frequency and percentage. One way ANOVA and chi square test were used for the comparisons. The p value ≤ 0.05 was considered as statistically significant.

RESULTS

There were 48 males and 12 females in the study population with a mean age of 34.7±9.2 years. Highest number of patients were from the age group of 31-40 years (30%) and lowest number of patients were from the age group of 11-20 years (5%). Among the patients, 40 had fracture on the right side and 20 had fracture on the left side and 18 of them received IM nailing, 12 received External fixator and 30 received MIPO.

The distribution of GA type fracture is shown in Table 1 where majority had Non GA type fractures (66.7%). The distribution of AO classification is shown in Table 2 where majority had A3 type fracture (30%).

Table 3 shows the comparison of the distribution of different modalities in different AO type of fractures where majority of IM nailing was done in A1 fracture (66.7%), majority of External Fixator was done in A3 and C3 fractures (33.3% each), and majority of MIPO was done in A3 fracture (80%). Chi square test proved that the difference was statistically significant ($p<0.001$).

The mean AOFAS score was highest in the patients treated with MIPO followed by IM nailing and External Fixator. One way ANOVA test proved that the difference was statistically significant ($p<0.001$) (Table 4).

Most of the complications were found in the patients treated with External Fixator followed by MIPO and IM nailing. And most number of varus and valgus deformities were found in the patients treated with External Fixator and IM nailing and least in the patients treated with MIPO (Table 5, 6).

Table 1. The distribution of GA type fractures

GA type	N	%
1	8	13.3%
2	2	3.3%
3A	10	16.7%
Non GA type	40	66.7%

Table 2. The distribution of AO classification

AO classification	N	%
A1	16	26.7%
A2	4	6.7%
A3	30	50.0%
B1	2	3.3%
C1	2	3.3%
C2	2	3.3%
C3	4	6.7%

Table 3. Comparison of the distribution of different modalities in different AO type of fractures

AO types	IM Nailing		External Fixator		MIPO		P value
	N	%	N	%	N	%	
A1	12	66.7%	0	0.0%	4	13.3%	<0.001
A2	4	22.2%	0	0.0%	0	0.0%	
A3	2	11.1%	4	33.3%	24	80%	
B1	0	0.0%	0	0.0%	2	6.7%	
C1	0	0.0%	2	16.7%	0	0.0%	
C2	0	0.0%	2	16.7%	0	0.0%	
C3	0	0.0%	4	33.3%	0	0.0%	
Total	18	100%	12	100%	30	100%	

Table 4. Comparison of mean score of American Orthopaedic Foot and Ankle Society (AOFAS) between the treatments

Treatment	Mean	SD	P value
IM Nailing	77.5	8.9	<0.001
External Fixator	70.2	6.4	
MIPO	88.3	9.1	

Table 5. Comparison of complications between the treatments

Complications	IM Nail		External Fixator		MIPO		P value
	N	%	N	%	N	%	
Stiffness of ankle	2	100%	4	40.0%	6	100%	0.125
Non-Union	0	0.0%	2	20.0%	0	0.0%	
Wound discharge	0	0.0%	4	40.0%	0	0.0%	
Total	2	100%	10	100%	6	100%	

Table 6. Comparison of Varus and Valgus deformity between the treatments

Deformity	IM Nailing		External Fixator		MIPO		P value
	N	%	N	%	N	%	
Varus	4	50.0%	2	25.0%	0	0	0.189
Valgus	4	50.0%	6	75.0%	4	100.0%	
Total	8	100.0%	8	100.0%	4	100.0%	

DISCUSSION

Enhanced functional outcomes have resulted from the evolution of cutting-edge surgical techniques thanks to increased knowledge of biomechanics, biology, and biomaterials. The goal of this research was to compare the effectiveness of different approaches to managing distal tibia fractures in terms of patient function. In the past, stabilisation was mostly accomplished through anatomical reduction and rigorous fixation. Delayed union and non-union due to injury to not hardened tissue surrounding the fracture site is disheartening. As a result, methods evolved and continued to develop that prioritised biology over stability.

Our research found that about one-third of our patients suffered open injuries that necessitated postponing the ultimate surgical procedures and were first treated with calcaneal pin traction till the wound healed. To stabilise the fracture temporarily while waiting for the not hardened tissue to heal before undergoing definitive surgery, we followed Robert E. leach's recommendation to employ calcaneal pin traction. There were a total of 60 patietns among them, 18 of them received IM nailing, 12 received External fixator and 30 received MIPO. Our research found that men were 80 percent more likely than women to get such injuries. Which was about the same as the 77 percent male preponderance seen in the study by Cory collinge et al.[9] High-energy trauma appears to be a main cause of such fractures, since the mean age of patients in our study was 40.5 years (Range 18 to 64 years), which is comparable to that of other studies, and nearly two-thirds of patients were between the ages of 21 and 40. Similar results were found in a study by Cory Colling et al., in which patients' ages ranged from 17 to 62, and in another study by Heather A. Vallier et al.[10], in which patients' ages were, on average, 39.1 years but could be anywhere from 16 to 77.

It was determined that the incidence of type A fracture was as high as 83.4%, while only 13.3% of cases with type C fractures were evaluated in the present study, making it impossible to compare the two. Two-eighths of patients in the Cory collinge et al. study had a type A fracture, whereas seventy-two percent had a type C fracture. There were 31 percent type A fractures, 21 perent type B fractures, and 44% type C fractures in the study by Heather A. Vallier et al.

The mean AOFAS score for patients cured with an IM nail was 77.5±8.9, while the scores for patients treated with an External Fixator (70.2±6.4) and MIPO (88.3±9.1) were respectively

lower and higher. The AOFAS score of 67.7 was similar to the AOFAS scores of 67.7 and 85.2 for external fixations and limited internal fixation (MIPO), respectively, in a research by Pierre Joveniaux et al.[11].

Varus/Valgus malalignment was defined as a deviation from neutral of more than 5 degrees in either direction. Four patients with IM nails and two patient with an external fixator had varus deformities higher than 5 degrees. Four patients of IM nail cases and four patients of MIPO cases had valgus deformities greater than 5 degrees. This demonstrates that external fixators, followed by IM nails and MIPO, result in the least amount of malalignment. It's not uncommon for people with misaligned bones to have trouble walking and experience discomfort when going about their regular routines. Using a sample of patients with distal tibial fractures, Puno et al. showed a correlation between joint malalignment and clinical prognosis. Postoperative complications included ankle stiffness, non-union, and wound drainage.

Four of the patients who were given external fixators experienced a postoperative infection, but it was only a skin infection that was easily managed with a local bandage and medication. Non-union was a problem for two patients treated with an external fixator, necessitating a second operation consisting of open reduction, internal fixation with plating and bone grafting from the iliac crest. Both wound drainage and ankle stiffness were reported as complications in two patients who had an external fixator. Patients who were administered MIPO, on the other hand, experienced no such side effects.

The sutures were removed either on postoperative day 12 or 14, depending on the condition of the wound. Patients were instructed to begin weight-bearing as soon as radiographic evidence of bone union was obtained, and this was continued as the patient's tolerance for it allowed. Partial weight bearing was often initiated between weeks 8 and 10, but was delayed until weeks 12 to 14 for patients with MIPO plating. Partial weight bearing was typically initiated between 8 and 10 weeks post-surgery; however, in MIPO-treated patients, weight bearing was delayed and initiated between 12 and 14 weeks post-surgery.

CONCLUSION

The present study used a patient-centered approach in which care was tailored to each patient based on factors such as wound type, injury severity, time of presentation, and accessibility to specialised medical facilities. soft tissue status, site of fracture, and participation of articular area also played significant role in individualising a treatment procedure for distal tibial fractures. The outcome was evaluated from clinical, radiological and functional aspects. Although IM nailing and External fixator have their own benefits based on the characteristics of the injury, our study showed that MIPO produced higher functional AOFAS score compared to those who underwent IM nailing or external fixation. Along with that, as MIPO has the advantages of conserving the biology of the fracture and restoring alignment more effectively, the clinical and radiological assessment also showed MIPO as better treatment modality than IM nailing and External fixator. Further research works in larger samples are recommended to explore various other perspectives of these treatment modalities.

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