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FUNCTIONAL OUTCOME OF DISTAL TIBIA FRACTURES MANAGED BY MINIMALLY INVASIVE PLATE OSTEOSYNTHESIS

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ABSTRACT

Aim: The aim of the present study was to assess the functional outcome of Distal third Tibia fractures managed by minimally invasive plate osteosynthesis.

Methods: This study included all patients admitted with fracture involving distal tibia fracture admitted at Department of Orthopaedics, JLN Medical College & Hospitals, Ajmer (Rajasthan), in between the duration of June 2022 to December 2023 treated with Minimally Invasive Percutaneous medial plate Osteosynthesis for tibia with or without fibula fixation after approval from Ethical Committee. During above mentioned period total 30 patients were treated for distal tibial fracture using MIPO (Minimally Invasive Plate Osteosynthesis) technique.

Results: Majority of the patients belonged to 20-60 years and there were male predominance. Majority of the patients had involved right side. 10 patients had AO type followed by C3. 50% patients had no associated injuries. 4 patients had superficial infection followed by implant prominence. 21 patients showed excellent result according to ankle score. According to Tenny & Wiss criteria, anatomic showed excellent results. 50% patients showed radiological union in 16 weeks.

Conclusion: Distal tibial fractures typically result from high-velocity trauma and are accompanied by severe soft tissue injury. Consequently, it raises the question of whether to give soft tissue or articular congruity and anatomic reduction priority. The functional outcome of MIPO technique for distal third tibial fractures was evaluated with this study. In our study we have found there is less of soft tissue damage and better bone healing with using MIPO technique.

Keywords: functional outcome, Distal third Tibia fractures, minimally invasive plate osteosynthesis

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1. INTRODUCTION

Fractures of distal tibia remains one of the most challenging for treatment because of limited soft tissue, the subcutaneous location and poor vascularity[1,2] and high complication rates both from initial injury and also from treatment.[3,4] All these fractures are severe injuries. They are increased in frequency because of higher incidences of Road Traffic Accidents. Accounts to 1% of all lower extremity fractures, 10% of tibial fractures and bilateral in 0-8% and compartment syndrome in 0-5%. Fractures of distal tibia remain a controversial subject despite advances in both non- operative and operative care. The goal in expect care is to realign the fracture, realign limb length and early functional recovery.[5] Non-surgical treatment is possible for stable fractures with minimal shortening, but malunion, shortening of affected leg, limitation of range of movement and early OA of ankle have all been reported following treatment of these fractures particularly pilon fractures.[2,6,7]

Surgical fixation of distal tibial fractures can be difficult, and require careful preoperative planning. Fracture pattern, soft tissue injury, and bone quality critically influence the selection of fixation technique. Several techniques have emerged – conservative, hybrid external fixation, external fixation with limited internal fixation, percutaneous plate osteosynthesis and intramedullary nailing. External fixation can be useful in open fractures with soft tissue injury which preclude nail or plate fixation, but may result in inaccurate reduction, a relatively high rate of malunion, or nonunion and pin tract infection.[8,9] With regards to Intramedullary nail, a stable fixation with nail in distal tibia may be difficult to achieve because the hourglass shape of the intramedullary canal prevents a tight endosteal fit and compromises torsional and angular stability.

Secondary displacement of the fracture on insertion of nail, breakage of nail and locking screws and malunion of the tibia are potential risks. Classic open reduction and internal plate fixation require extensive soft tissue dissection and periosteal stripping even in expert hands, with high rates of complications, including infection and delayed union and non-union.[10,11] A new advance in this field is represented by the “locked internal external fixators”. These devices consist of plate and screw systems where the screws are locked in the plate at a fixed angle. Screw locking minimizes the compressive forces exerted by the plate on the bone because the plate does not need to be tightly pressed against the bone to stabilize the fracture.[12,13]

The system works as flexible elastic fixation that putatively stimulates callus formation. The anatomical shape prevents primary displacement of the fracture caused by inexact contouring of a normal plate, and allows a better distribution of the angular and axial loading around the plate. As the plate is not compressed against the bone the periosteal supply is not disturbed which favors bone healing. Despite with advances in identification, understanding and treatment of soft tissue injury and with the liberal use of Computed Tomography scanning, advances in implant design which includes locking plate technology, still the management of these challenging fractures remains elusive.[14]

The aim of the present study was to assess the functional outcome of Distal third Tibia fractures managed by Minimally invasive plate osteosynthesis.

2. MATERIALS AND METHODS

This study included all patients admitted with fracture involving distal tibia fracture admitted at Department of Orthopaedics, JLN Medical College & Hospitals, Ajmer (Rajasthan), in

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between the duration of June 2022 to December 2023 treated with Minimally Invasive Percutaneous medial plate Osteosynthesis for tibia with or without fibula fixation after approval from Ethical Committee. During above mentioned period total 30 patients were treated for distal tibial fracture using MIPO (Minimally Invasive Plate Osteosynthesis) technique.

Inclusion Criteria

1. Adults > 18 years of age
2. Closed fractures and Gustilo Anderson Type I open fracture

Exclusion Criteria

1. Age <18 years
2. Medical contraindication for surgery
3. Pathological fracture
4. Gustilo Anderson Type II and III fracture

Methodology

Ethics committee approval was taken before commencing the study. Ruedi-Allgower classification was used to classify the fractures. Fracture was fixed with a distal tibia Locking Compression Plate using the Minimally Invasive Plate Osteosynthesis (MIPO) Technique without opening the fracture site. All the cases were operated by the same surgeons.The surgical incisions were irrigated and closed. Sterile dressings were applied and the limb was immobilized in a well padded posterior Below Knee slab with the ankle maintained in the neutral position and elevated on BB splint. All patients received 72 hrs of perioperative prophylactic intravenous antibiotics (Inj. Ceftrixone 1 gm and Inj Amikacin 500 mg twice daily).

Post-operatively, the limb was maintained in the elevated position and active toe movements advised. Then slab was removed after one week and compression bandage applied and ankle active range of movements were started. All patients were non-weight bearing for at least 6 weeks. Patents were reviewed in outpatient department at 10-14 days post-op for stitch removal and wound inspection. They were then reviewed at 4-8 weeks intervals until they were weight bearing fully with fracture united radiographically and clinically and postoperative complications had been identified and treated properly. Final evaluation was done at 6 months for distal tibial fractures as per Functional Score and Teeny and Wiss clinical assessment criteria.

Fig. 1: Armamentarium

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Fig. 2: Radiograph before surgery

Fig. 3: Surgical procedure

Fig. 4: Radiographic evaluation

Fig. 5: Complication (Superficial Infection)

3. RESULTS

Table 1: Patient characteristics

Age Group (years)	**No. of Patients**	**Percent**
20-40	13	43.33
41-60	12	40.00
60 & Above	5	16.67
Mean ± SD	**46.63 ± 12.9**	
Sex		
Male	22	73.33

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Female	8	26.67
Side		
Left	14	46.67
Right	16	53.33
AO Type		
AO Type	10	33.33
C1	7	23.33
C2	4	13.33
C3	9	30.00

Majority of the patients belonged to 20-60 years and there were male predominance. Majority of the patients had involved right side. 10 patients had AO type followed by C3.

Table 2: Associated Injuries

Associated Injuries	Number of Patients	Percent
SHAFT FEMUR	2	6.67
BBFA	2	6.67
DISTAL FIBULA	2	6.67
FRACTURE PROXIMAL	3	10.00
Head Injury	3	10.00
MT FRACT	2	6.67
Potts fracture	2	6.67
Chest injury	1	3.33
Nil	15	50

50% patients had no associated injuries.

Table 3: Complications

Complications	Number of Patients	Percent
Wound Dehicence	1	3.33
Implant Prominence	3	10.00
Superficial Infection	4	13.33
Implant Failure	1	3.33

4 patients had superficial infection followed by implant prominence.

Table 4: Ankle score

Ankle Score	Number of Patients	Percent
100-90 (Excellent)	21	70.00
89-80 (Good)	5	16.67
79-70 (Fair)	4	13.33
Total	**30**	**100.00**

21 patients showed excellent result according to ankle score.

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Table 5: Tenny & Wiss criteria

Reduction	AO Type A	AO Type C1	AO Type C2	AO Type C3	Total	Percent
Anatomic	8	6	4	4	22	73.3
Good	2	1	1	1	5	16.7
Fair	0	1	0	1	2	6.7
Poor	0	0	0	1	1	3.3

According to Tenny & Wiss criteria, anatomic showed excellent results.

Table 6: Radiological union

Union in weeks	Number of Patients	Percent
12 Weeks	3	10.00
16 Weeks	15	50.00
20 Weeks	12	40.00

50% patients showed radiological union in 16 weeks.

4. DISCUSSION

Tibia is one of the most commonly fractured long bone of the body.0.7% is the incidence of distal tibia fractures and it accounts to about 10-13% of all tibial fractures.[15] Fractures of distal tibia are among the most perplexing injuries. High energy motor vehicle accidents are the most common cause.[16] The management of distal tibia fractures is complex because of its unique anatomical characteristics of subcutaneous location with precarious blood supply, leading to postoperative complications and poor outcome. Therefore, the treatment of distal tibia fractures remains challenging. The distal tibialfracture should be treated as a type of "open fracture" due to its poor soft tissue envelope which will have been damaged from the injury, even without an The key principles in the management of these fractures – Restoration of the length and axis of the tibia and fibula; the reconstruction of the distal end of tibia; the filling of the defect resulting from impaction and the support of the medial side of tibia, by plating to prevent the varus deformity.[17]

In our study we used a single-stage fixation of all distal tibial fractures. We used medial distal tibial locking compression plate for all cases. This plate is a low profile plate of 3.5 mm system. The Medial distal tibial plate is a pre- contoured plate to that of the distal tibia and thus allows placement of the plate without disruption of fractures fragments. The thread holes in the plate locks to that of the screw head and minimize plate-bone interface and maintain the vascularity at the fracture site. The peak incidence in our study was among the age group between 25-75 years. In our study we had excellent and good functional outcome in about 26 cases (87%) and 4 cases (13%) of fair outcome based on IOWA scores. As per TEENY WISS SCORE we had good anatomic rating in about 22 cases (72%), good rating in about 5 cases (18%), fair in 2 cases (8%) and one case (2%) of poor rating.

Mast et al[18] recommended primary definitive internal fixation if the patient was presented early within 8 to 12 hours following injury. They advocated a delay in the definitive procedure for about 7 to 10 days for soft tissue to heal, if the patient presented late. In our study the average duration of delay in the definitive treatment was about 5 to 8 days. Patterson and Cole et al[19] reported an impressive 0% infection rate following fixation after an average of 24 days,

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however this study is limited by its relatively small sample size. In our study we had a delay of about 5 to 8 days before going for definitive stabilization.

Barei et al[20] demonstrated that distal tibial fractures with intact fibula, on the whole was considered as less severe injury than those with fractured fibula. An intact fibula was identified as less severely injured than C type fractures. The first principle of management by Ruedi and Allgower was restoration of fibular length which remains vital to obtaining good results. The goal of fibula fixation was restoration of limb length, to prevent varus tilt and rotation and gross mechanical alignment. Of the 30 cases, 5 cases of fracture fibula had gross displacement which required fixation with rush pin. The rest of the cases were not fixed as most of the fractures were undisplaced stable fractures or it was fractured at different levels. All fibula fractures healed within 3 months without any gross complications.[21-23]

Helfet et al in their study had a superficial infection rate of 3% and deep infection of 6 % in their series of 32 fractures treated with locking compression plate. In our study we had 4 cases (13%) of superficial infection which was comparable to the above study.[24,25] McCann PA et al[26] in their study of complication of definitive open reduction and internal fixation of distal tibial fractures, they had good functional result in 73.7% cases and 5% of deep infection rate in a follow up of 30.4 months. In our study we had 70% of good functional outcome which was acceptable when compared to the above study.

Joveniaux P et al[27] in their study of distal tibia fracture: management and complication, they had a functional score of 76% in their series. Their result had 20 cases of excellent, 15 cases of good, 9 cases of fair and 6 cases of poor in their series of 50 cases. In our study we had nearly 21 cases of excellent outcome, 5 cases of good, 4 cases of fair among the 30 cases. Ronga M et al[28] in their study of minimally invasive locked plating of distal tibial fractures, they had the following outcomes – of the 21 cases they achieved union in 20 cases and one case went in for non-union. They had 3 cases of angular deformities all less than 7° and no patient had a leg-length discrepancy. Compared to their study, in our study we used MIPPO with no case of malunion or nonunion.

Pugh KJ et al[29] in their study of locking plate fixation in distal tibial fractures – series of 79 patients, had reported about 88% of healing without malunion, 2.5% of malunion and 3.7% of non-union. They used both MIPPO and ORIF for fixing these fractures. They found good and early union rate in the MIPPO group. In our study also we had good and early union in the MIPPO group and also we had no case of malunion or non-union. Pugh and colleague evaluated 60 patients, 25 of whom were treated with external fixators. They noted that they had more number of malunion in the external fixator group compared to that of internal fixation. They met most of their complication in the external fixator group. In our study also we had good functional outcome in internal fixation group.

The average follow up period our study was 9.4 months (range from 6 to 20 months). In type III fractures patients may develop late secondary arthrosis, but it requires a longer follow up. In our series, the results of the patients who had long follow up period of more than 22 months had good clinical scores despite some early mild arthritic changes in type C severe communited fractures. Arthrodesis was indicated when there was extensive comminution and also in severe type III fractures. In our study, type III injuries accounted for 22% of the cases and arthrodesis was not done in any of our patients, compared to that of 23 % of cases in a study by M. Blauthet et al. Marsh et al reported an arthrodesis rate of 13 % in their series of 40 ankle fractures after a minimum follow up of 5 years. Chen noted a 4.7% arthrodesis rate in plating tibial plafond fractures when followed for a period of 10 years. Since our study was a short term study, arthrodesis could not be commented which might require a long term follow up. The incidence of head injury or spinal cord injury was less in our series compared to other studies. Among 30

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cases 3 (1%) cases of head injury and among 30 cases 46% of our cases had associated other bony injuries like fractures of Both Bone Forearm, Chest Injury (Rib fracture), Shaft of femur fracture, fibula and metatarsal fracture. Hence the outcome of surgically treated distal tibial fractures depends on the associated injury to and the management of, the soft tissues surrounding the injury and accuracy of the articular reduction. A correlation exists between the severity of the fracture, overall outcome and the development of secondary degenerative arthritis, open wound.

5. CONCLUSION

Distal tibial fractures typically result from high-velocity trauma and are accompanied by severe soft tissue injury. Consequently, it raises the question of whether to give soft tissue or articular congruity and anatomic reduction priority. The functional outcome of MIPO technique for distal third tibial fractures was evaluated with this study. In our study we have found there is less of soft tissue damage and better bone healing with using MIPO technique.

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