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ISSN No: 2319-5886

International Journal of Medical Research & Health Sciences, 2016, 5, 6:276-282

Management of fractures of the extra articular distal tibia by minimally invasive plate Osteosynthesis—A prospective series of 21 patients

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ABSTRACT

Extra articular distal tibial fractures are frequently encountered by the orthopaedician due to high incidence of road traffic accidents. Our aim is to study clinical and radiological outcome in extra-articular distal tibia fractures treated by minimally invasive plate osteosynthesis (MIPO). 21 patients were treated with minimally invasive plate osteosynthesis by locking compression plate (MIPO) who attended the OPD and emergency of department of Orthopaedics, Silchar Medical College & Hospital who met the inclusion criteria for a period of 1 year 01/06/2014 – 31/05/2015. Patients were followed up for clinical and radiological evaluation at 6 weeks, 12 weeks, 20 weeks, 24 weeks, 6 months and 1 year. The mean age of the patients was 39.09 years ±10.13 with 15 males and 6 females with 52.38% having left tibia involvement. The average time for union in our study was 21.70 ± 2.67 weeks. Also the average time required for partial and full weight bearing was 6.90 ± 1.33 weeks and 13.38 ± 1.24 weeks . Implant irritation and ankle stiffness were the main complications noted in our study. Average Functional outcome according to AOFAS score was measured in our study which came out to be 96.52 ± 4.16 and by Johner and Wruh's criteria, showed that majority of the patients in the study had satisfactory functional results i.e. 76.18%. MIPO is an acceptable modality for treatment in terms of union while exposing the patient to lesser soft tissue trauma. Implant irritation is the complication due to its superficial implant. Larger RCTs are required for confirming the results.

Keywords: Extraarticular distal tibia, Mipo, Plate fixation

INTRODUCTION

Fractures of distal tibia are among the most challenging injuries faced by the surgeon. The common concern among these fractures is associated soft tissue injury component and if not treated properly may result in serious complications and disability[1]. High energy motor vehicle accidents constitute the lead cause especially in the middle aged adult male because of their more outdoor activity[2].The incidence of distal tibia fractures in most series is 0.6 % and it constitutes to about 10-13% of all tibial fractures[3].Stable fixation becomes a difficult task as it is devoid of muscular attachments.

Open reduction and Plate fixation is effective in stabilizing distaltibia fractures but it is met with extensive soft tissue dissection and increased chances of infection[4,5]. Percutaneous plating techniques is gaining widespread popularity as it allows stabilization of distal tibia fractures while preserving vascularity of the soft-tissue envelope. Difficult learning curve, chances of infection are the possible complications noted with this technique[6,7,8].These techniques aim to reduce surgical trauma and to maintain a more biologically favorable environment for fracture healing.

The present study was hence undertaken to study the surgical management of closed extrarticular distal tibia fractures with minimally invasive plate osteosynthesis, the functional outcome and the various complications associated with it.

MATERIALS AND METHODS

In this study, skeletally matured 21 patients with extra articular distal tibial fractures AO type 43A1, 43A2, 43A3 were selected who attended the OPD and emergency of department of Orthopaedics, Silchar Medical College & Hospital who met the inclusion criteria outlined below for a period of 1 year 01/06/2014 – 31/05/2015. An informed consent was obtained from each patient prior to participation in the study. Inclusion criteria included fracture meeting the AO criteria, age more than 18 years, those who gave valid consent, presence of distal fragment of at least 3 cm in length without articular incongruity, duration of injury < 2 weeks, competent neurological and vascular status of the affected limb and patients who meet the medical standards for routine elective surgery. Patient with open fractures, intra articular extension, pathological fractures, poor medical health or who didn't give consent were excluded. Patient with open fractures, intra articular extension, pathological fractures, poor medical health or who didn't give consent were excluded. An informed consent was obtained from each patient prior to participation in the study. All the patients were examined in detail and worked up to obtain pre-anaesthetic clearance. X-rays were done routinely in all the cases. Clinical and radiological parameters were recorded.

Prophylactic intravenous (iv) antibiotics were administered 30 minutes prior to skin incision.

Surgical techniques

Patients were operated under spinal anesthesia in supine position on a standard radiolucent table. The key concept of the approaches to the distal tibia is preserving the soft tissue envelope and the blood supply in the fractured metaphyseal area. Generally, the plate is inserted from distal to proximal through a tunnel between periosteum and intact overlying tissue. The medial approach is commonly used for the MIPO technique.

A straight skin incision 3–5 cm is performed on the medial aspect of the distal tibia. The incision stops distally at the tip of the medial malleolus. The greater saphenous vein and saphenous nerve are held anteriorly with a blunt retractor. Separate stab incisions are usually sufficient for the insertion of the proximal screws in the diaphysis. It may be necessary to perform further stab incisions at the level of the fracture to percutaneously apply reduction forceps or insert a separate lag screw for better reduction especially in oblique or spiral fracture patterns at the metadiaphysis.

In this epiperiosteal space tunnelling towards the diaphysis can easily be achieved by using the blunt tip of the plate or an epiperiosteal tunnelling instrument.

Reduction is achieved with manual traction and manipulation. Anatomically precontoured plate is inserted above the epiperiosteal space from distal to proximal on the anteromedial aspect of the tibia. First the plate is adjusted to the periarticular part of the tibia. It is important that the plate is in the correct position in relation to the joint space. After insertion of plate and achieving the reduction, the plate is temporarily fixed to bone with K wires. Then the plate is fixed to proximal fragment with one locking screw under image intensifier guidance through a small stab incision. The screw is then used as a hinge to rotate the plate clockwise or anticlockwise as required for accurate placement. Distal fragment fixation is done with combination of locking and cortical screws. The whole part was finally confirmed with IITV. The wounds are all closed in layers. Sterile dressings were applied over the wounds. The limb is wrapped in a compressive dressing.

POSTOPERATIVE PROTOCOL

Radiograph with standard antero-posterior and lateral view of the involved leg was taken immediate post operatively, at 6 weekly intervals till union and at 1 year follow up. Active range of movements of knee and ankle joint along with quadriceps strengthening exercises were started on the next day of surgery. Weight bearing was started after radiographic assessment showed signs of union as bridging callus in 3 out of 4 cortices and clinically as absence of tenderness and movement at the fracture site[9].This finding suggested the fracture site has sufficiently consolidated so as to allow partial weight bearing which usually occurs by 6-8 weeks.

A clinical evaluation for the functional assessment of the ankle was obtained at each visit by using the AOFAS score. The final results at the end of 1 year follow up were evaluated using the "Johner &Wruhs' Criteria" as excellent, good, fair and poor[10].

RESULTS

In our study,21 patients of extra articular distal tibial fractures, the mean age of the patients was 39.09 years ± 10.13 SD with range from 20 to 59 years. There were 15 males and 6 females in the study with 52.38% having left tibia involvement. (Table no 1)

Extra articular distal tibial fractures were classified according to AO classification, the most common type 43A1 which accounts 10 patients i.e.(47.61%) followed by 9(42.85%) type 43A2 and 2 (9.52%)type 43A3.

The commonest mode of injury was RTA (Road Traffic Accident) seen in 66.67% patients followed by falls, sports injury (e.g. football) and assault. More than half (61.90%) were operated within 3 to 7 days of injury.
Case operated after 7 days as due to limb was swollen and blisters formation over the fracture so we waits for once blisters and swelling settled down.

The operating duration mean was 66.67±5.55 min with ranged from 60-80 minutes. No single case of injury to great saphenous vein and saphenous nerve was detected. The mean time for starting partial weight bearing is 6.90 ± 1.33 weeks. The average time for full weight bearing was 13.38 ± 1.24 weeks. The union occurred in an average of 21.70±2.67 weeks (range 16-24 weeks).

Table no 1: Demographic and observational data

PARAMETER	NUMBER
Male	15
Female	6
Mean age (years ± SD)	39.09 years ± 10.13 SD
Mechanism of injury	
Road traffic accidents	14 (66.67%)
Falls	3 (14.28%)
Assault	3 (14.28%)
Sports injury	1 (4.76%)
AO Classification	
Type 43A1	10 (47.61%)
Type 43A2	9 (42.85%)
Type 43A3	2 (9.52%)
Duration of surgery (in minutes)	66.67 ± 5.55
Weight bearing (in weeks ± SD)	
Partial weight bearing	6.90 ± 1.33
Full weight bearing	13.38 ± 1.24
Union time (in weeks ± SD)	21.70 ± 2.67

The functional results, as assessed by Johner and Wruh's criteria, showed that majority52.38%of the patients in the study had excellent functional results and 28.57% had good results. Functional outcome according to AOFAS score was measured in our study which came out to mean score was 96.52 ± 4.16.

Figure no 1: Distal tibial fractures, preoperative and immediate post operative x rays

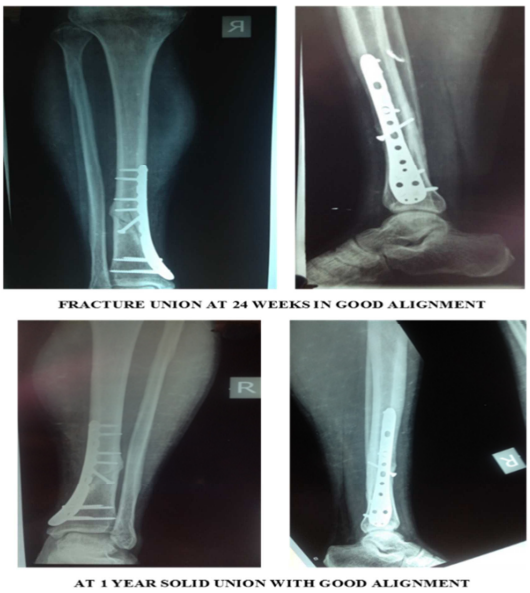

Figure no 2: Distal tibial fractures x rays showing union at 24 weeks and 1 year.

Implant irritation (23.80%), ankle stiffness (23.80%) and infection (19.04%)were the main complications noted amongst patients.

DISCUSSION

Extra articular distal tibial fracture which are presented to the orthopaedician, often poses a challenge to the surgeon as status of soft tissue and degree of comminution itself complicates the plan of management. The goal of operative treatment is to obtain anatomical alignment 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.

With the development of minimally invasive surgery, percutaneous plating has challenged interlocking nailing as locked plate designs act as fixed-angle devices whose stability is provided by the axial and angular stability at the screw-plate interface instead of relying on the frictional force between the plate and bone, which is thought to preserve the periosteal blood supply around the fracture site[6-8].

Understanding of the mechanical background for choosing the proper implant length and the type and number of screws is essential to obtain a sound fixation with a high plate span ratio and a low plate screw density. A high plate span ratio decreases the load onto the plate. A high working length of the plate reduces the screw loading, thus fewer screws need to be inserted and the plate screw density can be kept low[11,12].

In our study, the patients were in the range from 20 to 59 years, with mean age being 39.09 years ± 10.13 SDyears. Out of the 21 patients, the gender distribution was as 15 males; 6 females. Predominant male involvement in our study was probably due to more outdoor activities and heavier labor undertaken by males as compared to females in the Indian set up. The result were comparable to that of Bahari etal[13], Redfern etal[14], Sitnik etal[15], Paluvadi etal[16]. (Table no 2)

In our study most common cause for these fractures was road traffic accident (R.T.A) followed by fall and sports injury especially football. Our results were comparable to other studies Deebak etal[17], Eknath etal[18] which also showed that RTA is the most common mode of injury as modernization and industrialization has intruded our lives.
In our study, the operating time in the lock plate it ranged from 60-80 minutes (mean 66.67±5.55 min). This was comparable to studies done by Paluvadi etal[16] , Guo etal[19] and Hasenbohler et al[20].Operative time was longer in AO 43A1 fractures in those cases in which a percutaneous lag screw was inserted and in the 5 patients with a concomitant fibular fracture needing fixation. We recommend one percutaneous lag screws of adequate length in all spiral/oblique fractures from lateral to medial side before MIPO so as not to jeopardise medial plate application. This provisional fixation makes further MIPO easier. If possible lag screws can be inserted through plate and they provide better strength to.

The mean time for starting partial weight bearing in 6.90 ± 1.33 weeks.In our study, we allowed partial weight bearing only after signs of union in form of bridging callus on at least 3 cortices out of 4 cortices on radiograph and clinically as absence of tenderness and movement at the fracture site[11]which was usually by 6-8 weeks. Majority of the cases, having fulfilling above criteria around 6-8 weeks and were allowed partial weight bearing on the affected limb.

The average time for full weight bearing was 13.38 ±1.24 weeks. The mean time of union in our study was 22.75±1.99 weeks. In our study 20 fractures (92.58%) united between 16-24 weeks which was similar to study done by Guo J J et al.[19]

Tibial fractures are often associated with fibular fractures which might impact the treatment modality and ultimately the final reduction and union. Whether to fix the fibular fracture or not is the question of the hour. Fixation of fibula was done in 14 / 21cases (59.45%) in our study. 1 case of delayed union in were noted in our study in which fibular fixation was done. With respect to secondary procedures to achieve union, we achieved union by bone grafting and fibular osteotomy at around 24 weeks. Various studies [21-25] have hypothesized that fibula fixation may facilitate anatomic reduction of the tibia; however, it is possible that the fibula then reduces strain over the tibia fracture, which heightens the potential for delayed healing or nonunion. This requests the need for larger RCTs for finalizing a protocol for associated fibular fractures.

In our study, we had acceptable alignment in 18 cases i.e. 85.72%. Malalignment was found in 14.28% patients. This was comparable to studies by Sitnik etal[15] and Ronga M etal[26]. In our study of 3 cases which had malalignment evident on immediate postoperative period healed in same position at follow up of 1 year and no significant change was noted. This finding suggests intraoperative error could be the prime cause for malunion and it also throws light on difficulty in reducing the distal fragment accurately. 1cases had valgus and 2 case had varus malunion were noted.

In our study implant irritation(23.80%) and ankle stiffness (23.80%) were the most common complications in MIPO. Deep infection was seen in 1 patient (4.76%), superficial infection in 3 patients (14.28%) in plating group, superficial wound infections healed with extended period of intravenous antibiotics but patient with wound breakdown needed repeated debridement as well. As RTA was the commonest cause in our study, alongwith causing the fracture, it might also affect the soft tissue. This may leads to soft tissue disintegrity and infections. Our study was comparable for complications with other studies which were conducted by Bahari et al[13],Redfern et al[14], Guo J J[19]and Borg etal[27].

Table no 2: Comparison of current study with previous clinical series

Studies	No of patients	Average age of patient (in yrs)	Average operative time (in mins)	Average time to union	Post operative infection (%)	Malalignment (%)	Delayed/ Nonunions (%)	Mean AOFAS score at union (Max 100)
Bahari et al[13]	42	35 yrs	–	22.4 wks	7.14%			
Redfern et al[14]	20	38.3 yrs	–	23 wks	5%	5%	0	–
Sitnik et al[15]	80	43 yrs	–	87.5%by 6 month (m)	9%	6%	13%	–
J J Guo et al[19]	54	44.4 yrs	97.9 min	17.6 wks	14.6%	–	–	83.9
Hasenbohler et al[20]	32	45 yrs	86.6 min	75% at 6 m, 84% at 9 m	3.4%	0	17.2%	–
Ronga et al[26]	21	–	–	–	42.3%	19%	4.8%	–
Borg et al[27]	21	–	82 min	5.44 m	14.3%	28.5%	19%	–
Collinge et al[28]	38	–	–	21 wks	All inf. Superficial	2.63%	8%	85
Current study	21	39.09 yrs ± 10.13 yrs	66.67±5.55 min	21.70 ± 2.67 wks	19.04%	14.28 %	4.76 %	96.52 ± 4.16

Functional outcome according to AOFAS score was measured in our study which came out to mean score was 96.52±4.16, which was similar to studies by Paluvadi etal[16], Guo et al[19]and Collinge et al[28].(Table no 2)

CONCLUSION

Minimally invasive plate osteosynthesis by locking plate have shown a reliable method of fixation for distal tibial fractures. This procedures preserving most of the osseous vascularity, fracture hematoma which provide biological repair so there is lesser incidence of delayed union and non-union .This technique can be used in fractures where locked nailing cannot be done like distal tibial fractures with small distal metaphyseal fragments and comminuted fractures. The decision to fix the fibula was based on intraoperative reduction of tibia fracture. If significant malalignment was still persisting after fixation of tibia, only then the decision to fix fibula fracture was made. Thus we do not recommend fibular fixation routinely because the essential benefit of closed MIPO in the avoidance of soft tissue dissection might be compromised in this way and also reduces strain over the tibial fracture, which heightens the potential for delayed healing or nonunion but to support this , larger trial are needed. Implant prominence and its related complications because of mismatching of the implant contouring and supra malleolar anatomy especially in thin built patients . Meticulous soft tissue handling is imperative. A Randomized Controlled Trial, possibly triple blinded or at least double blinded in nature, involving a large number of patients with long term follow-up is clearly needed to bring the differences between the two techniques.

Acknowledgments
We are thankful to the patients enrolled in this study and department of Orthopaedics, Silchar medical college, Silchar Assam.

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