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Original Research Article

Ankle spanning external fixator with limited internal fixation for distal tibial extra-articular fractures

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ABSTRACT

Background: Fractures of the distal tibia are among the most difficult fractures to treat. The short distal segment presents difficulty in choosing the appropriate fixation method. The greatest challenge lies in the relatively tight soft tissue around the ankle. As a result, it has been a recent interest in treating these fractures with external fixation and limited internal fixation. The external stable fixation methods used are tubular or ring fixators, with or without immobilising the ankle. This minimally invasive nature of the surgery can avoid catastrophic wound complications like dehiscence, implant exposure and infection.
Methods: 18 patients with extra-articular distal tibial fractures (AO Type 43A) were treated with the technique of ankle spanning external fixation. Lag screws or K-wires were supplemented for limited internal fixation when required. Fibula was stabilised in all cases. Intra- articular and Compound fractures were excluded. In addition to union at fracture site, ankle pain and motion was noted in each follow-up.
Results: The mean follow-up was 25 months. Of the 18 patients included all but one fractures united with an average healing time of 16 to 18 weeks. Ankle pain and motion was graded according to Mazur modified by Teeny and Wiss clinical scoring system. 15 of them had excellent or good results, 2 had fair results. One patient had poor result. Five pin tract infections occurred. 17 patients had no evidence of osteoarthritis after completing follow up of at least 2 years.
Conclusions: Distal tibial fractures are complex injuries, not only regarding the bony component, but also in terms of the management of the soft tissue problem. Ankle Spanning External Fixator with Limited Internal fixation is a relatively simple and cost-effective method for treating these fractures, achieving union and also maintaining ankle function.

Keywords: Ankle spanning, Distal tibia, Extra-articular fractures, Non-hinged external fixator

INTRODUCTION

Fractures of the distal tibia are among the most difficult fractures to treat. The short distal segment presents difficulty in choosing the appropriate fixation method. Challenge also lies in the relatively tight soft tissue and gross swelling around the ankle associated with these fractures. The intra-articular group of these injuries - the pilon or plafond fracture, need articular reconstruction for maximal ankle function. Many methods have been described for treating the distal tibial fractures, whether intra or extra-articular. These methods include closed or open reduction followed by intramedullary locked nailing, plate and screw fixation, ring fixator, tubular

fixator and hybrid fixator. Fixators can be applied in various combinations and configurations ranging from ankle spanning or sparing. If spanning, the fixator can be, articulated (hinged) or non-articulated.

To avoid catastrophic wound complications like dehiscence, implant exposure and infection associated with plating, these fractures especially extra-articular can be managed with external fixation and limited internal fixation, achieving both fracture union and ankle function. Two staged surgery has also been proposed.[1-12] In first stage external fixator is applied, and when skin condition is favourable i.e. usually 2-3 weeks, plating is done. This staged procedure is also fraught with wound complications of plating and moreover patient undergoes morbidity of two operations. Nailing also has its limitations of providing stability to small distal fragement.[13,14]

The aim of the present study was to assess the union, functional outcome and osteoarthrosis of ankle, in distal tibial extra-articular fractures treated by ankle spanning tubular external fixator along with limited internal fixation. (LIFE F-Limited Internal Fixation with External Fixation).

METHODS

Between August 2012 and July 2015, 18 patients with extra-articular distal tibial fractures (AO Type 43A) admitted to our institute were included in the study. Compound and displaced intra-articular, distal tibial fractures were excluded. At time of presentation all ankles had marked swelling. 12 ankles had blisters also.

After due assessment, evaluation and initial management, all patients were treated with the technique of ankle spanning non-articulated external fixation. Lag screws or K-wires were supplemented for limited internal fixation according to fracture configuration. Fibula was stabilised in all cases, either with compression plating or K-wire. Among the type 43A fractures, six were A1; five were A2 and seven where of A3 type. The average age of the four female and 14 male patients was 38 years (range 21 to 65 years).

Operative technique

After informed consent, patient was operated. The fibula was stabilised first by either 2.5mm or 3.00mm K-wire or by plate. Plate preferred in fibula was Locked Reconstruction (3.5mm).

The distal tibial metaphyseal fragment was aligned to proximal segment and checked under image intensifier. A large metaphyseal fragment where required was opened by limited incision and fixed to diaphyseal fragment by interfragmentary lag screw. K-wire if required was percutaneously passed from distal metaphyseal to proximal diaphyseal fragment from medial malleolus according to fracture pattern.

Next, one 6.5mm Schanz pin was inserted medially in calcaneum, two Schanz pin (4.5mm) inserted in proximal tibial fragment anteromedially and one Schanz pin (3.5mm) in neck of first metatarsal, all the time maintaining alignment at fracture site, checking under image intensifier and keeping ankle in neutral position. All the pins were connected to each other in triangular pattern (Figure 1).

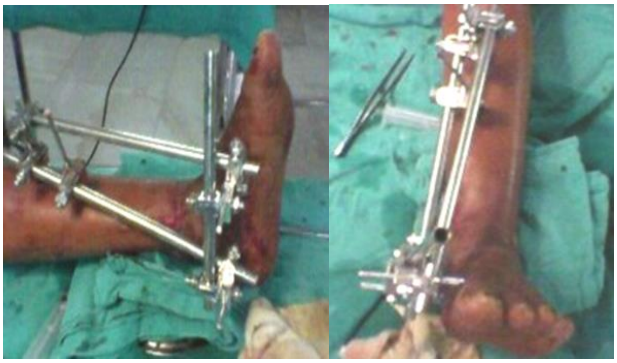

Figure 1: Clinical photograph of fixator configuration.

Post-operative protocol

Limb was maintained in elevated position for swelling to subside. Knee movements and non-weight bearing walk was started next day. Ankle radiographs- AP (anteroposterior) and Lateral (Lat.) were taken post operatively. Partial weight bearing was started at 4-6 weeks. At 6-8 weeks, external fixator was removed after assessing union. Ankle brace was applied, intermittent ankle physiotherapy started and patient asked to walk full weight bearing with support according to pain tolerance. 10- 12 weeks post operatively brace was removed and patient continued on ankle physiotherapy and full weight bearing walk.

At 6, 12, 18 and 24 weeks clinico-radiological assessment was done for union, alignment and shortening. Then follow up was done at 6 monthly intervals for minimum of 2 years to assess malunion, ankle functional score and osteoarthrosis ankle.

Ankle function scoring was done by Mazur Scoring modified by Teeny and Wiss[15,1] (Table 1 and Table 2)

Malunion was defined as angulation >5° as described by Marsh et al.[8] Shortening was considered significant if >2cm. Even though extra-articular fractures were included in study, osteoarthrosis was graded according to criteria of Marsh and Bonar.[6] Grade 0 indicated no evidence of arthrosis; grade 1, small spurs but no joint space narrowing, grade 2, osteophytes and some joint-

space narrowing; and grade 3, complete loss of the joint space.

Table 1: Symptoms and functional evaluation of ankle.

Parameters	Points
Pain	50
Distance	8
Supports or Orthosis	8
Running	5
Toe raising	5
Hills (up or down)	3
Stairs (up or down)	3
Limp	8
Swelling	3
Plantar range of motion	2
Dorsal range of motion	5

Table 2: Clinical rating.

Rating	Score
Excellent	> 92 points
Good	87-92 points
Fair	65-86 points
Poor	< 65 points

RESULTS

The mean follows up was 25 months (range 24-28 months). Of the 18-patient included in study all but one fracture united with an average healing time of 16-18 weeks (Figure 2, 3, 4, 5).

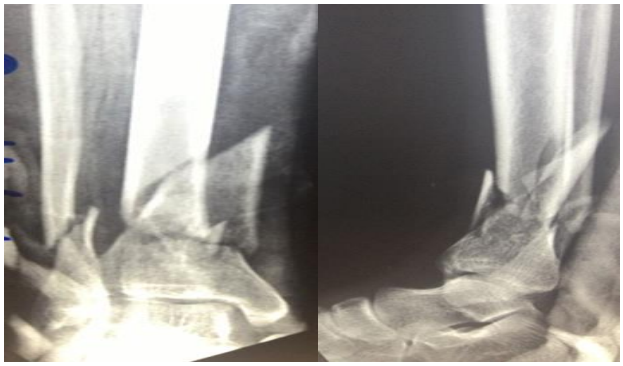

Figure 2: AP and lat radiograph.

Mean injury to operation interval was 3 days (range 2-8 days). Delay in operation in 2 patients was due to co-morbid medical conditions. Average stay in hospital was 9 days (range 7-15 days). Mean duration for which external fixator kept was 7.5±1.2 weeks. Mean Ankle brace duration was 4.3±1.8 weeks. So, period for which ankle got immobilized, was 11.8±1.6 weeks. Pin tract infection occurred in 5 patients (27%). All were superficial and healed by pin tract care. 2 patients had valgus malunion of 6° and 7° each. 6 patients had <5° angulations and were not considered as malunion. 10 patients had no angulation at union site. Shortening of < 2cm was present in 6 patients; others had no limb length discrepancy. In spite of shortening in these patients none had gait abnormality. The shortening in all the seven Type 43A3 fractures and in 3 of the 5 patients of type 43A2 fractures.

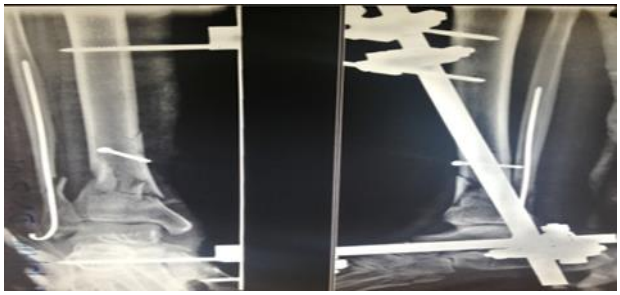

Figure 3: Postoperative radiograph showing interfragmentary lag screw and ankle spanning external fixator.

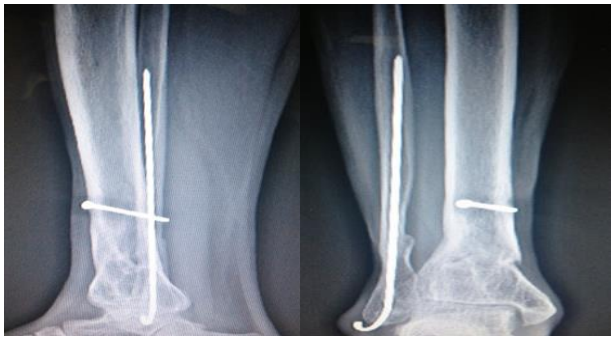

Figure 4: 2 years postoperative radiograph showing union with no signs of ostearthrosis.

According to modified Mazur scoring 10 patients had excellent, 5 had good results, 2 patients had fair and one had poor result. After a mean follow up of 24 months one patient had evidence of osteoarthritis and moderate amount of pain at ankle. Other 17 had no evidence of osteoarthritic changes radiologically or clinically as compared to contralateral ankle. One patient which had non-union was managed by open reduction, medial distal tibial metaphyseal locked plate with bone grafting. The fracture subsequently united.

Figure 5: clinical photograph showing comparable dorsiflexion and plantarflexion of both ankles.

DISCUSSION

The results of operative treatment of distal tibia fractures are dependent on the severity of the initial injury, the quality and stability of the reduction. The status of soft tissue and degree of comminution, affects the long terms clinical result. Most of studies in literature of distal tibia fractures are on pilon or plafond i.e. intra-articular fractures. Our emphasis was on extra-articular distal tibia fracture as both behave similarly apart from risk of osteoarthrosis in the former group. The goal of tibial fixation is to maximize fracture stability without increasing soft tissue morbidity from surgical interventions. Failure to recognize this often results in repeated surgery and even amputation.[4]

Reudi and Allogower reported 74% excellent or good results with open reduction and internal fixation of tibial plafond fractures.[16] Some authors (Ovadia and Beals - 77%, Bourne RB, Etter a Ganz 50%) also reported good result as them.[2,3,17] But some authors reported poor result along with high rate of complication. Tenny and Wiss reported 37% of patients having deep infections and McFerran reported 40% having major complication after plating of distal tibial fracture.[1,18] Wyrsch et al reported 16% (3 out of 19 patients) amputations after open reduction and internal fixation.[4] These reports reflected the fact that with extensive surgical dissection and in achieving an anatomical reduction the devascularized bone fragments were source of infection. More over infection of plate in already compromised soft tissue further jeopardized the vascularity effecting wound healing. The results of external fixation were reported to be good by Barbieri 90%, Marsh 69%, Bone 95% [7]and Tornetta.[5,6,9]

There is no denying that anatomical reduction is crucial in reconstruction of articular surface to achieve pain free ankle motion, but it is less important regarding the metaphyseal fragment as included in our study. Recommendation is to preserve biology of bony fragment. The concept of external fixation when combined with minimal internal fixation deals with both mechanical and biological healing of fracture.

Reduction is achieved through ligamentotaxis and surgical dissection is bypassed. Wyrsch et al compared open reduction and internal fixation versus external fixation with or without limited internal fixation and showed similar functional result in both groups.[4] The latter group was associated with lesser complication also. Marsh et al compared external fixation in tibial plafond fractures with or without ankle hinge.[19] They concluded that there was no difference in health status, ankle status and range of motion between articulated hinged external fixator versus locked hinged external fixator.

Okcu et al reviewed the results of tibial plafond fractures either by ankle sparing ilizarov ring fixator or by spanning technique using monolateral articulated external fixator.[20] They concluded that both techniques had no stability difference with regards to mean functional score, radiographic score and late complications, although ilizarov group had better ankle movements.

Fixation failure is high with external fixators that do not cross the ankle as stated by Kapukaya et al who used ankle spanning circular ring fixator for distal tibial fracture.[21] Antoci et al studied biomechanics of external fixator of distal tibia extra-articular fracture in vitro and recommended spanning of ankle with foot plate.[22] Pugh et al studied outcome using an ankle spanning unilateral frame, an ankle sparing ring hybrid fixator and ORIF in fractures of tibial plafond finding no difference in rate of complications and union in the three groups.[23] Bone et al concluded that cross ankle fixators which completely immobilize the ankle joint have not been detrimental to patient.[7]

In our study, functional range of ankle movement was maintained in all patients. All these studies corroborate our results of spanning the ankle with the fixator without any hinge, with no deleterious effect on ankle movement or increasing the chances of osteoarthritis. The spanning fixator increases the stability of fracture reduction as malunion was seen in only 2 of 18 patients.

Fibula

Leung et al stated that rigid fixation of fibula on lateral side may predispose to varus alignment during fracture healing especially in marked tibial metaphyseal comminution.[24] Varsolona and Liu studied the role of fibular fixation in distal tibial metaphyseal fracture and concluded that it is not necessary to fix it, if fracture is above syndesmosis.[25] They also preferred external fixation as compared to nailing in these fractures. We recommend fixation of fibula in all cases as done in our series to maintain length, rotation and lateral wall stability.

CONCLUSION

Distal tibial fractures are complex injuries, not only regarding the bony component, but also in terms of the management of the soft tissue problem.

Ankle Spanning External Fixator and Limited Internal fixation is a relatively simple and cost-effective method for treating these fractures, achieving union and also maintaining ankle function.

It not only reduces financial burden on patient but also lessens the mental and physical trauma of second surgery. Keeping ankle immobile by non articulated external fixator doesn't alter the results.

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Ethical approval: Not required

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