

# Outcome of management of closed distal tibia fractures using staged surgical protocol.

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## ABSTRACT

**INTRODUCTION:** Complex fracture geometry and delicate soft tissues in the ankle region makes surgical treatment of distal tibial fractures challenging. In this study, we evaluated clinical and radiological outcomes following staged procedures for management of closed distal tibia fractures.

**METHODS:** This is a retrospective study with two-staged procedure for management of distal tibia fracture of patients treated between September 2017 and October 2019. Initial management consisted of ankle-spanning external fixator application with or without fibular fixation. Definitive procedure was done after soft tissue healing. Either minimally invasive procedures or open reduction and plating were done on the basis of fracture geometry. Clinical outcome was evaluated based on fracture healing, soft-tissue problems and infection, pain and mobility. Olerud-Molander Ankle Scoring system (OMAS) was used for evaluation of functional outcome.

**RESULTS:** Twenty-seven patients were included in the final evaluation and had at least one-year follow-up. Three patients (11.1 percent) had superficial infection with partial thickness skin necrosis and one (3.7 percent) had deep infection. There was no incidence of pin tract infection. Average fracture union time was 14 weeks ( $14.37 \pm 1.735$ ). Result of Olerud-Molander Ankle Scoring system (OMAS) score at one year was excellent in 22 patients (81.4 percent).

**CONCLUSION:** This retrospective study showed a good clinical outcome in patients with closed distal tibia fractures managed with staged protocol with minimal complications, thus making an invaluable addition of cases to the existing literature. We believe that two-stage protocol can significantly reduce soft tissue complications inherent to this injury and provide better surgical outcome.

**KEYWORDS:** Ankle-spanning external fixator, distal tibia fractures, Two-stage procedure

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## INTRODUCTION

Distal tibia fractures continue to remain a challenge for Orthopaedic surgeons. Precarious soft-tissue envelope and poor vascularity predisposes to increased skin complications and wound infection following surgery. Immediate surgery in presence of swelling and skin blisters can lead to devastating complications like skin necrosis, osteomyelitis and can even result in amputation.<sup>1</sup> Use of an ankle spanning external fixator as a temporizing measure to allow for soft tissue recovery before a definitive surgery, and use of minimally

invasive techniques when feasible, can help in mitigating these issues. Use of a temporizing external fixator also helps in maintaining length and alignment of tibia. In addition, this allows for mobilization of the patient, which is not possible with just a posterior plaster slab application.<sup>1,2</sup> Intramedullary nailing is a good option for diaphyseal fractures. However, due to a wide metaphyseal area in distal third of tibia, it is technically challenging and can lead to primary and secondary mal-alignment.<sup>3</sup> Anterior knee pain is also a common problem following intramedullary nailing.<sup>4,5</sup>

The purpose of study is to evaluate the clinical

outcome of staged management of closed distal tibia fractures with temporizing external fixator followed by definitive fixation.

## METHODS

This is a retrospective review of patients with closed distal tibia with or without fibula fracture who were treated at Nobel Medical College Teaching Hospital between September 2017 and October 2019 using staged protocol. An Institutional Review Committee clearance was obtained for the study. All skeletally mature patients with closed distal tibia fractures who presented to the Nobel Medical College emergency room or outpatient department were included in the study. All subtypes of AO/ OTA fracture type 43 were included in the study.<sup>6</sup> Patients with pathological fractures, open fractures, lower limbs with neurological deficits and vascular insufficiency and skeletal immaturity were excluded. Diabetics were well monitored and smokers were highly discouraged to smoke during the course of treatment.

Clinical and radiological evaluation was done in all patients who presented in emergency department with distal tibia fractures. Antero-posterior and lateral view X-rays of leg including ankle were done in all patients. Computed tomography (CT) scans were sent for patients with intra-articular fractures after application of ankle-spanning external fixator.

Patients were operated under spinal anesthesia. 1.5 grams of intravenous cefuroxime was administered 30 minutes prior to surgery. Pneumatic tourniquet was applied on the thigh and standard radiolucent table was used.

In the first stage, patients with associated lateral malleolus fracture underwent osteosyntheses of fibula with reconstruction plate. Fibula was not operated in the first stage in cases where posterolateral approach to fix the Volkmann's fragment was anticipated. Ankle-spanning external fixator was then applied with two Schanz-pins in the proximal fragment avoiding the zone of injury and area of subsequent surgical incision for plating. Denham pin was inserted in the calcaneum and a delta-shaped construct was

created using tubular rods and clamps.

In the second stage, definitive surgery was planned after soft tissue swelling subsided and appearance of wrinkle on dorsiflexion and eversion of foot. This was done within two weeks of external fixator application. Average waiting time was 9.5 days (7 to 13 days).



Figure 1: Open reduction and internal fixation of fibula with reconstruction plate and application of ankle-spanning external fixator

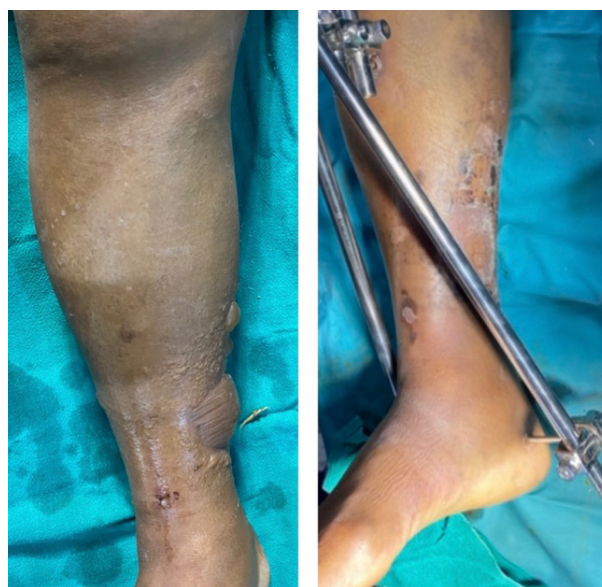


Figure 2: Presence of soft tissue swelling and blisters. Note the healing of blisters and appearance of wrinkle after 8 days.

In the operating room, external fixator was removed after spinal anesthesia. Part preparation was done with 5% povidone-iodine solution and sterile drapes applied.

In extra-articular and undisplaced intra-articular fractures minimally invasive plate osteosyntheses (MIPPO) was done.<sup>7</sup> Locking compression plate around twice the length of

fracture comminution was chosen. Around 5 cm vertical incision was made over the medial malleolus and an epi-periosteal plane was created using blunt dissection. Under C-arm guidance plate was slid from distal to proximal direction. About 3 cm incision was made in the proximal tibia to aid plate positioning. Pointed reduction forceps and non-locking screws were used as indirect reduction tools. Stab incisions were used to fill minimum of three bi-cortical screws proximally whereas both uni-cortical and bi-cortical screws were used in the distal metaphyseal portion.

In displaced intra-articular fractures, open reduction and, as far as possible, anatomic reconstruction of articular fragments were achieved with lag screws and augmented with buttress plates. Extra-articular portion of the fracture was bridged using the MIPPO technique.

Finally, the wound was irrigated with normal saline and closure was done in layers. Dressing was done and removable below-knee posterior plaster slab was applied for two weeks. Limb

was elevated and analgesics were given for pain relief. Intravenous antibiotics was continued till the first dressing change on the third post-operative day. If the wound was healthy, patients were discharged from the hospital on oral antibiotics.

Non-weight bearing crutch-mobilization and intermittent range of motion exercises of toes was started on day one of surgery and intermittent ankle mobilization was started on day three (after the first dressing). Patients were followed up at two weeks for suture removal. Touch weight bearing was started at 6 weeks postoperatively and weight bearing was progressed gradually depending on the fracture configuration and healing. Clinical and radiological evaluations were done every 6 weeks, 3 months, 6 months and 12 months after surgery, until fracture union. Surgical sites were graded according to Centers for Disease Control (CDC) criteria as healthy, superficial incisional surgical site infection or deep incisional surgical site infection.<sup>8</sup> Olerud-Molander Ankle Scoring system (OMAS) was used in this study to assess the final results.<sup>9</sup>

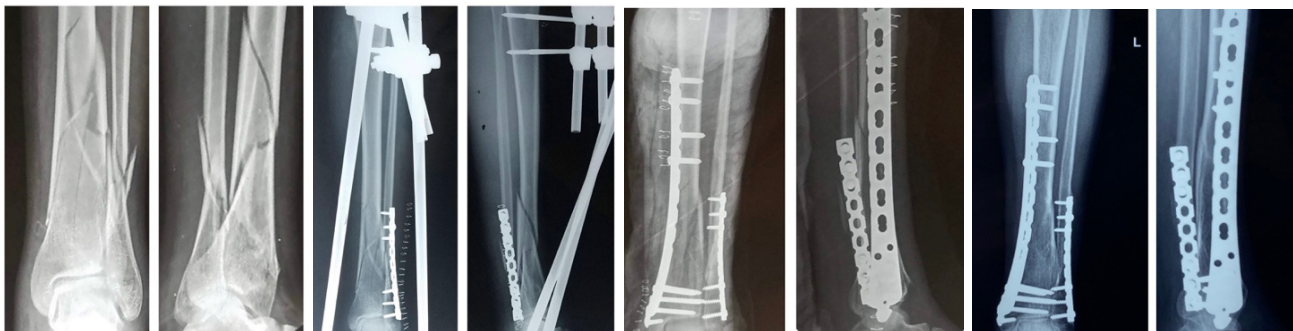


Figure 3: 43A3 fracture managed with staged procedure. Well-healed fracture at two-year follow-up

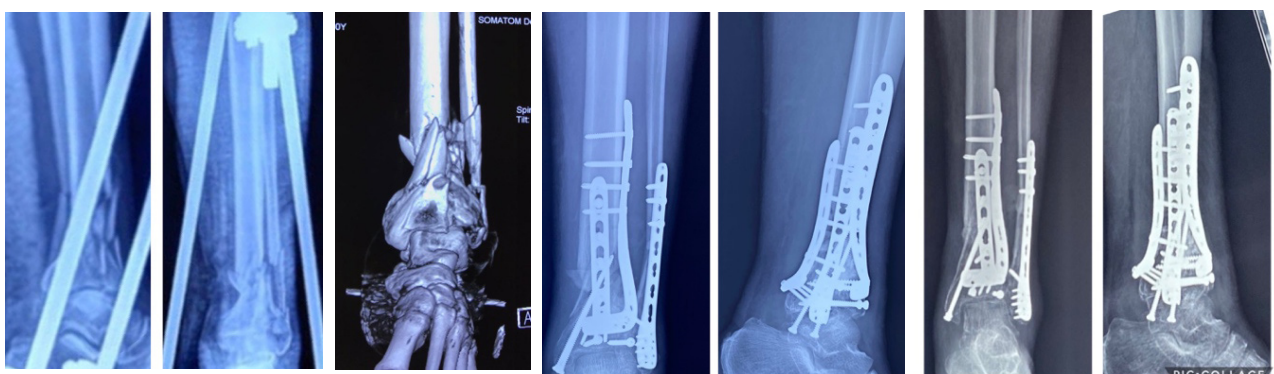


Figure 4: Staged procedure for 43C3 fracture. CT scan was done after application of spanning external fixator. Fracture healed without wound complications.



Note the well-healed surgical incisions and good ankle range of motion at one-year follow-up.:

For the statistical analysis, SPSS version 17 was used. For descriptive data analysis, mean and standard deviation were calculated. For the comparison between categorical data, Fischer's exact test was used. For comparison between categorical and continuous data, independent Student t- test was used with confidence interval of 95% and p-value of 0.05.



Figure 5: Follow-up case of a patient managed with staged procedure for distal tibia fracture.

## RESULTS

Twenty-nine patients with closed distal tibia fractures with or without fibula fractures were treated in a staged manner in this period. Two patients were lost to follow-up. Therefore, 27 patients were included in the final evaluation and were followed up for at least one year. The mean age of the patient was  $41.7 \pm 10.3$  years with male preponderance (Table 1). The major mechanism of injury was road traffic accident. Nineteen cases were AO/OTA type 43A, five cases were type 43B and 3 cases were of type 43C. Five patients were smokers and two were

diabetics. The average days from injury to stage 1 surgery was  $1 \pm 0.7$  days (range, 0- 2 days) and for stage 2 surgery was  $9.6 \pm 1.9$  days (range, 7 -13 days).

Table 1: Patient Demographics and Injury Details

<b>Age (years <math>\pm</math> Standard Deviation)</b>	<b>41.7 <math>\pm</math> 10.3</b>
<b>Sex</b>	
Male	19 (70.4)
Female	8 (29.6)
<b>Mechanism of injury</b>	
Fall	6 (22.2)
Road traffic accidents	19 (70.4)
Sports	2 (7.4)
<b>AO/OTA Classification</b>	
A1	3 (11.1)
A2	8 (29.6)
A3	8 (29.6)
B1	1 (3.7)
B2	4 (14.8)
C1	2 (7.4)
C3	1 (3.7)
<b>Fracture side</b>	
Right	16 (59.3)
Left	11 (40.7)
Associated fibula Fracture	23 (85.2)
Smoker	5 (18.5)
Diabetics	2 (7.4)
The values are given as the number of patients and their percentages in the parentheses.	

The average time to union was 14.4 weeks (range, 11 to 18 weeks) in all but one patient. The fracture in one patient showed delayed union, however, it healed without any further surgery to potentiate healing at around 28 weeks. The average OMAS score at 6 months was 94.1 and it increased to 97.2 at the end of one year. At one year, there were 22 cases (81.5%) with excellent results and 5 (18.5%) with good results (Table 2).

Table 2: Clinical Outcome

<b>Average union time (weeks)</b>	<b>14.37 ± 1.735 (11 – 18)</b>
<b>Soft tissue Complication</b>	
Superficial infection	3 (11.1)
Deep Infection	1 (3.7)
Partial thickness necrosis	3(11.1)
Full thickness necrosis	0
<b>Other Complications</b>	
Pin tract infection	0
Delayed union	1 (3.7)
Non-union	0
Malunion	0
<b>Average OMAS at 6 months</b>	<b>94.07 ± 6.51</b>
Excellent	16 (59.3)
Good	11 (40.7)
Fair	0
Poor	0
<b>Average OMAS at 1 year</b>	<b>97.22 ± 5.06</b>
Excellent	22 (81.5)
Good	5 (18.5)
Fair	0
Poor	0
The values are given as the number of patients and their percentage in the parentheses.	

Three patients (11.1%) had superficial infection with partial thickness skin necrosis and one patient (3.7%) had deep wound infection. Superficial infection healed with local wound care and antibiotics. Deep infection occurred in a diabetic lady whose blood glucose level was well monitored. She was treated with wound debridement and culture specific intravenous antibiotics for two weeks followed by oral antibiotics for four more weeks. Data analysis did not show significant association between diabetes and rate of infection (p value- 0.083). There were only two diabetics in our study. So, the number of patients were too small to give any statistical significance. Functional outcome as per OMAS score was excellent in 81.5% of patients at one-year follow-up and all fractures healed with only one incidence of delayed union which healed without any intervention.

During data analysis, comparison between

OMAS scores at six months and one year was found to be statistically significant ( $p$ -value 0.006). Independent sample t-test for comparison between time taken before stage two surgery and OMAS score at 6 months as well as at one year had  $p$ -values of 0.09 and 0.13 respectively. The average days before stage two surgery was  $9.63 \pm 1.9$  (range, 7 to 13 days).

## DISCUSSION

Reports in the literature have shown high rate of wound complications following fixation of distal tibia fractures.<sup>10,11</sup> This may, possibly, be due to immediate attempts of surgery in a swollen and compromised soft tissue. Non-operative management with cast application can be considered in low demand and medically co-morbid patients. However, secondary displacement of fractures frequently complicates non-operative management of distal tibia fractures and often lead to mal-alignments, commonly varus-deformity. Prolonged immobilization can cause deep vein thrombosis, embolism and post-traumatic joint stiffness.<sup>12,13</sup> Moreover, in intra-articular distal tibia fractures anatomic restoration of joint cannot be achieved by conservative measures.<sup>1,14</sup>

Bourne et al. in their study of surgical management of distal tibia reported deep infection in 13% of their patients with high energy injuries.<sup>15</sup> McFerran et al. in their study of 51 patients, encountered major local complications in 40 percent of their cases.<sup>11</sup>

High complication rates with internal fixation led surgeons to evaluate application of external fixators along with minimally invasive techniques. However, high rates of pin tract infection, malunion, non-union and post-traumatic arthritis have been reported.<sup>16</sup> In the present, none of the patients developed pin tract problems as they were applied for less than two weeks.

Applying the principle of staged protocol in the setting of both closed and open distal tibia fractures has shown promising outcomes.<sup>1, 2, 17, 18</sup> Helfet et al. in their series of twenty patients with distal tibia fracture managed with staged

protocol demonstrated good functional and radiological outcomes with no incidence of deep infection.<sup>19</sup> Sirkin et al. reported partial thickness skin necrosis in 17% of patients with closed pilon fractures treated with staged procedure.<sup>1</sup> In the present series, three patients (11.1%) had superficial infection with partial thickness skin necrosis and one patient (3.7%) had deep wound infection.

In their study, Helfet et al. reported that all fractures healed without the need for a second operation and time to full weight-bearing averaged 10.7 weeks (range 8-16 weeks).<sup>19</sup> Patterson MJ. in his study reported that twenty-one out of twenty-two fractures healed within an average of 4.2 months.<sup>18</sup> The mean union time was 14.4 weeks (range, 11-18 weeks) in this study population.

On comparing the OMAS scores at six months and at one year, a statistically significant difference was found. This maybe probably due to progressive physiotherapy and many patients returning to pre-injury functional level at one year follow up. A comparison was also done to see if time duration between two stages affected the final functional outcome. However, OMAS score at 6 months and at one year was not found to be statistically significant. This clearly highlights that delaying the definitive surgery by up to two weeks, to allow for soft-tissue healing, does not influence the final functional outcome. Therefore, we may safely delay definitive fixation by staging the surgery for better outcome.

Although this study supports and adds to the existing literature about importance of staging surgery for distal tibia fractures, it has number of limitations. First of all, this is a retrospective study with its inherent biases. Secondly, the sample size is small to make the results generalizable. Finally, all subtypes of AO/OTA type 43 were included in this study thus this study will not be able to delineate healing and other issues related to each fracture subtype.

## CONCLUSION

This retrospective study showed good clinical

outcome in patients with closed distal tibia fractures managed with staged protocol with minimal complications, thus making an invaluable addition of cases to the existing literature. We believe that two-stage protocol can significantly reduce soft tissue complications inherent to this injury and provide better surgical outcome.

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