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**Original Research Article**

# A prospective randomized comparative study on fractures of lower third of both bones of the leg treated by interlock nailing of tibia with or without fixation of fibula

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## ABSTRACT

**Background:** In the treatment of fractures of the distal third of tibia and fibula treated by interlocking nail of tibia, the role of fixing the fibular fracture is not clearly defined. This study was conducted to assess the benefits of fixation of fibular fracture in distal third leg bones fractures.
**Methods:** 95 patients were enrolled into study and divided randomly into two groups based on whether fibula fixed or not with interlock intramedullary nailing tibia. Patients were followed for an average period of 11 months both radiologically and clinically.
**Results:** We observed that the average valgus angulation was significantly less (P =0.001) in the group where fibula was fixed. The outcome of the two groups for clinical ankle score, time of union and complication showed no difference (P ≥0.05).
**Conclusions:** We concluded that fixation of fibula decrease the malalignment of tibia in distal third fractures of tibia and fibula treated with interlocking nail of tibia.

**Keywords:** Tibia, Fibula, Interlocking nail, Valgus angulation, Ankle score

## INTRODUCTION

Treating distal third leg bones fractures is still a great challenge. Considering its anatomy, it is commonly difficult to achieve reduction and maintenance on distal third tibial bone fractures. Reduction is even more difficult when a fibular fracture is found at the same level as the tibia. This fracture pattern reflects a high-energy mechanism of trauma causing an increased angular and rotational instability, limb shortening and soft parts injuries.[1,2]

The treatment modalities described for tibia and fibula fractures range from simple cast immobilization to complex surgical procedures.[3] Considerable concern exists that malalignment of a healed tibial shaft fracture may result in post-traumatic arthritis of the ankle or knee.[4] As the location of the deformity approaches ankle or knee, malalignment results in maldistribution of articular surface pressures that may predispose a patient to premature osteoarthritis.[5,6] The location of the mal-union is important, with distal deformities more likely to be symptomatic.[7]

In the treatment of fractures of the distal third of tibia and fibula, the fibular fracture is often ignored and is not fixed because rarely is any specific treatment required for the fibula. The role of the fibula in maintaining stability after fixation of distal tibial fractures has not been clearly defined.[8,9] To the best of my knowledge only few studies done on the effect of fibular fixation in patients with

fractures of the both bones of lower third leg treated with intramedullary nailing of tibia. To study the clinical relevance of fibular fixation in lower one third fractures of both bones of leg and in an effort to outline the advantage and benefits of fixation of the fibula, in comparison with those without fixation, this study was undertaken.

## METHODS

A study of 95 patients who had fractures of the lower third of tibia and fibula was undertaken in SMS Medical College and Hospital from November 2013 to June 2015. The purpose of the study was to compare the effects of fixation of fibula in fractures of the lower third of leg with those with no fixation of fibula, the fracture tibia being treated with interlocking intramedullary nail in all the cases.

### *Inclusion criteria*

Patients with fractures of the lower one third of shaft of tibia and fibula, fresh cases of lower one third leg fractures, patients who attained skeletal maturity when assessed radiographically, closed and Gustilo type I and type II open lower one third diaphyseal fractures of the leg were included in the study.

### *Exclusion criteria*

Patients with upper one third and middle one third fractures of the both bones of the leg, who did not attain skeletal maturity when assessed radiologically, segmental fractures of the tibia, fractures with intraarticular extension where interlocking nailing of the tibia was not feasible and Gustilo type III open fractures were excluded from the study.

### *Operative procedure*

*Technique of interlocking nailing of the tibia*

All cases were managed under spinal anaesthesia. Preoperatively a calcaneal Steinmann pin was put for all the patients. An image intensifier with a C-arm was used in all the cases to provide fluoroscopic guidance. The patient was positioned supine on the fracture table. A well padded bar was put beneath the proximal thigh avoiding any pressure in the popliteal area. The hip was flexed to 70 – 90$^{o}$ and the knee flexed at 60 – 90$^{o}$.

Longitudinal traction if required was applied along the calcaneal skeletal pin. Rotational alignment was achieved by aligning the anterior superior iliac spine, patella and second ray of the foot. A five centimeter incision was made medial to the patellar ligament. Using a curved awl, the medullary canal was opened proximal to the tibial tuberosity at the level corresponding to the proximal tip of the fibular head. The bone awl was centered in the medullary canal.

A curved 3.2 mm ball tipped guide wire was inserted to the level of the fracture. The proximal fragment was reduced to the distal fragment. Under C-arm guidance, the guide wire was advanced in to the distal fragment, centering both in anteroposterior and lateral views. The guide wire was introduced 0.5 to 1 cm proximal to the ankle joint.

The entire tibia was reamed using cannulated reamers over the guide wire in 0.5 mm increments until the desired diameter has been achieved. A nail 1 to 1.5 mm smaller than the final reamer was selected. The 3.2 mm guide wire was exchanged for a 3.00 mm non-balled guide wire; a medullary exchange tube was used to avoid loss of fracture reduction.

The selected nail was attached to the proximal drill guide with the hexagonal bolt. The nail was driven over the guide rod until the nail has entered the metaphysis of the distal fragment. The guide wire was then withdrawn. The nail was driven further until the proximal tip of the nail was countersunk into the tibial entry portal. With the final hammer blows for seating the nail, the traction was released from the leg and counter pressure applied through the foot to close any fracture gap. Locking screws were inserted using a free hand technique with the help of image intensifier.

*Technique of fibula fixation*

*Open reduction and fixation with one third tubular plate*

The fibula was fixed first in all the 48 cases. After painting and draping the leg, a straight incision that parallels the shaft of lower third of the fibula was made. The subcutaneous tissue was not undermined. The fracture site was opened and reduction held with bone holding clamps. The fracture was fixed with one-third tubular plate and cortical screws.

*Long K-wire fixation of the fibula*

Under C-arm guidance, intramedullary long k-wire was passed from the tip of the lateral malleolus.

Either one of the above methods was used for fixing the fibula in all the cases based on fracture pattern of the fibula and density of the bone.

### *Postoperative regime*

Post operatively all the patients were mobilized non-weight-bearing with crutches or walker as soon as pain and local condition permit. Mobilization of the knee and ankle was also started in the immediate postoperative period. Sutures were removed on 14th day of surgery.

X-ray of the involved leg was taken postoperatively including both knee and ankle joints in the same film. Patients were followed up clinically and radiographically

at one month, two months, four months and six months and yearly intervals. Data was collected by verbal communication, clinical examination and radiographic features. In the postoperative radiographs tibial malalignment was measured. The degree of the tibial angulation [varus or valgus] was measured on the anteroposterior radiographs by determining the angle formed by the intersection between the perpendicular lines drawn from the tibial plateau and tibial plafond.[10,11]

At the end of six months, the range of movement [dorsiflexion and plantar flexion] at the ankle was determined. A clinical evaluation for the functional assessment of the ankle was obtained by using the "Ankle-Evaluation Rating System" by Merchant and Deitz.[10] The final results were evaluated using the "Johner&Wruhs' Criteria" as excellent, good, fair and poor.[12]

The data was analyzed by student's unpaired t-test by SPSS 6 version software. The value of p <0.05 was considered for statistical significance.

## RESULTS

Table 1 demonstrates the distribution of age with sex of the participants in the study. All the cases went for valgus angulation irrespective of whether fibula was fixed or not. To assess the effect of angulation, the patients were divided into 4 groups as Excellent: 0-1$^o$ valgus/varus**;** Good: 2–5$^o$ valgus/varus**;** Fair: 6–10$^o$ valgus/varus**;** Poor: >10$^o$ valgus/varus. [12] The average valgus deformity of the tibia in patients in whom fibula was fixed was 6.68$^o$ and that in whom fibula was not fixed was 9.08$^o$ as shown in Table 2.

**Table 1: Age distribution with sex.**

| Age group (in years) | Fibula fixation | | | No Fibula fixation | | |
|---|---|---|---|---|---|---|
| | Male n (%) | Female n (%) | Total n (%) | Male n (%) | Female n (%) | Total n (%) |
| **17-26** | 18 (38.30) | 1 (17.02) | 19 (40.42) | 20 (41.67) | 2 (4.17) | 22 (45.83) |
| **27-36** | 10 (21.28) | 3 (55.32) | 13 (27.66) | 11 (22.92) | 2 (4.17) | 13 (27.08) |
| **37-46** | 9 (19.15) | 3 (3.16) | 12 (25.53) | 6 (12.50) | 1 (2.08) | 7 (14.58) |
| **47+** | 3 (6.38) | 0 (0.00) | 3 (6.38) | 6 (12.50) | 0 (0.00) | 6 (12.50) |
| **Total** | 40 (85.11) | 7 (14.89) | 47 (100.00) | 43 (89.48) | 5 (10.42) | 48 (100.00) |

**Table 2: Mean radiological valgus score.**

| | Fibula fixation | | P- value | Significance |
|---|---|---|---|---|
| | Done | Not done | | |
| **Valgus** | 6.68±2.76 | 9.08±2.56 | <0.001 | HS |

To assess the range of movements at the ankle, the patients were divided in to 4 groups as Excellent: 100% motion of ankle; Good: >75% motion of ankle; Fair: 50-75% motion of ankle; Poor: <50% motion of ankle.[12] In our study, 38.03% of patients with fibular fixation had good results, 51.06% of patients had fair and 10.64% had poor results. Among the patients in whom fibula was not fixed 10.42% had good results, 64.58% had fair and 25% had poor results as shown in Table 3.

**Table 3: Mean range of motion at the ankle.**

| | Fibula fixation | | P-value | Significance |
|---|---|---|---|---|
| | Done | Not Done | | |
| **Range of motion** | 67.25±10.09 | 67.30±10.73 | >0.05 | NS |

**Table 4: Ankle evaluation rating (clinical).**

| | Fibula fixation | | P-value | Significance |
|---|---|---|---|---|
| | Done | Not Done | | |
| **Aers** | 65.55±13.35 | 69.49±10.45 | >0.05 | NS |

A clinical assessment of ankle function according to the criteria of Merchant and Dietz was determined for each ankle at the end of six months follow-up. It is a 100 point scale allotting 40 points for function, 40 for pain, and 10 for gait and 10 points for range of motion at the ankle. The mean clinical score in cases where fibular fixation was done was 65.55 points and for those where no fixation was done for the fibula was 69.49 points as given in Table 4.

The mean time of union in both the groups were almost similar as presented in Table 5. Table 6 explains the number of cases affected with infection postoperatively in both the groups.

**Table 5: Mean pattern of time of union.**

| | Fibula fixation | | P-value | Significance |
|---|---|---|---|---|
| | Done | Not Done | | |
| **Union** | 5.73±1.51 | 5.20±0.80 | >0.05 | NS |

**Table 6: Complications.**

| Infection | Fibula fixation | | Total n (%) |
|---|---|---|---|
| | Done n (%) | Not done n (%) | |
| **Yes** | 10 (10.53) | 1 (1.05) | 11 (11.58) |
| **No** | 37 (38.95) | 47 (49.47) | 84 (88.42) |
| **Total** | 47 (49.47) | 48 (50.53) | 95 (100.00) |

**Table 7: Final results according to Johner and Wruh's criteria.**

| Outcome | Fibula fixation | | Total n (%) |
|---|---|---|---|
| | Done n (%) | Not done n (%) | |
| **Good** | 9 (9.47) | 5 (5.26) | 14 (14.74) |
| **Fair** | 35 (36.84) | 43 (45.26) | 78 (82.10) |
| **Poor** | 3 (3.16) | 0 (0.00) | 3 (3.16) |
| **Total** | 47 (49.47) | 48 (50.53) | 95 (100.00) |

According to Johner and Wruh's criteria patients were divided into four groups – those with excellent, good, fair and poor results.[12] Among the cases with fibula fixed, 9 (19.14%) had good results, 35 (74.46%) had fair and 3 (6.38%) poor result. Among the 47 patients in whom fibula fixation was not done, 5 (10.41%) had good results and 43 (89.58%) had fair results as shown in Table 7.

## DISCUSSION

The role of fibula fixation in distal third fractures of the shaft of tibia and fibula has not been clearly defined.[8,9,11] This study was conducted in 95 patients to analyse the results of fixing the fibula fracture in fractures of the lower third of shaft of tibia and fibula when compared with cases in which fibula is not fixed. In all of the cases, the fracture tibia was treated with interlocking intramedullary nailing.

The demographics of the two groups, with and without fibular fixation were similar with respect to age, sex, side of the fracture, fracture classification, nature of the injury and open fractures.

In all of the 95 patients, irrespective of whether fibula was fixed or not, there was valgus angulation at the fracture site. The probable reasons could be: (1) the relatively wider diameter of the medullary canal of the distal fragment decreases the amount of fixation with less contact surface between the nail and the bone.[13] This in turn can result in the distal fragment going for valgus/varus angulation (2) the short distal tibial segment (3) the most important factor in avoiding malreduction of distal fragment is ensuring that the guidewire is placed in the exact middle of the medullary canal and that it is perpendicular to the tibial plafond. Any variation from this can result in the distal segment going for valgus/varus angulation.[14] (4) Comminution at the fracture site.

The average valgus angulation was significantly less (0.001) when fibula was fixed compared to those where fibula was not fixed. The fixation of the fibula establishes the length of the lateral column. When the fixation of the fibula is done prior to nailing of the tibia, it helps to restore the alignment of proximal and distal tibial fragments.[8] This may be the reason for less valgus angulation in cases where fibula was fixed.

Range of motion at the ankle was statistically similar in patients with and without fixation of the fibula . Merchant and Deitz in their clinical study of 37 patients followed up for 29 years, had a mean ankle evaluation score of 88.4 points for patients with distal third of the shaft of tibia.[9] All of the patients in their series were treated non-operatively with a cast.

In this study, the mean ankle evaluation score for patients in whom fibula was fixed was 65.55 points and 69.49 points for patients without fibular fixation i.e. the ankle evaluation score was statistically similar in patients with and without fixation of fibula. In our study the less mean score when compared to the study by Merchant & Deitz may be accounted to the shorter duration of the follow up in this study [the longest duration of follow up being one year's four months with a mean duration of 11 months].

Patients treated with fixation of fibula had comparatively higher complications than those without fibula fixation. Ten out of 47 patients treated with fixation of fibula developed superficial wound infections over the fibular wound site. All the ten infections were controlled by appropriate dressing and antibiotics, Assessment of results according to Johner & Wruh's criteria showed that the distribution of results were statistically similar between patients with and without fibula fixation.

## CONCLUSION

Based on the results of the study, the following conclusions were reached. The tibia malalignment [valgus angulation] was significantly less (0.001) in patients in whom fibula was fixed in lower third tibia and fibula fractures compared to those in whom fibula was not fixed. The functional score after 6 months follow up between patients with and without fibula fixation were statistically similar. There is no significant difference in the time of union of the tibial fracture between the two groups of patients. The rates of complications are significantly higher in patients in whom fibula was fixed compared to those in whom fibula was not fixed.

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