ORIGINAL RESEARCH

Assessing Functional Recovery in Distal Third Both Bone Leg Fractures: Impact of Fibula Fixation

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Received date: 23 January, 2024 Acceptance date: 27 February, 2024

ABSTRACT

Background: This study investigates the impact of fibula fixation in conjunction with intramedullary tibial nailing on functional recovery in distal third leg fractures, focusing on the escalating road traffic injuries in India. **Material and method:** Eighty patients aged 18-70 were divided into groups with and without fibula fixation, assessing outcomes through the RUST SCORE, Johner and Wruhs criteria, and the Ankle-Evaluation Rating System. **Result:** Predominantly right-sided and closed fractures were observed, with both groups experiencing valgus angulation, albeit lower in patients with fibular fixation. Union was achieved within 12 months, with a slightly prolonged duration in fibula fixation cases. Fibula fixation demonstrated marginal advantages in ankle range of motion and function at six months. The study underscores the need to consider individual patient factors, contributing vital insights to the ongoing discourse on distal tibia and fibula fracture management, prompting further research and consensus-building.

Keywords: distal tibia fractures, fibula fixation, intramedullary nailing, functional recovery, road traffic injuries.

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INTRODUCTION

The increase in road traffic brought about by industrialization and technology has resulted in over 1,58,700 fatalities and injuries from traffic accidents annually in India, a country with a higher frequency of these incidents (WHO global safety report 2018).[1] Tibial diaphyseal fractures, particularly in the distal third region are common, constituting about 37% of all tibia shaft fractures. The subcutaneous nature of the tibia's shaft throughout its length can lead to severe complications and significant disability.[2,3,4,5]

Distal tibia fractures pose greater treatment challenges than mid-diaphyseal tibia shaft fractures. Intramedullary interlocking nails offer advantages such as fewer wound complications and early mobilisation. However, fractures at the distal tibia have higher rates of complications like non-union, malunion, and malalignment. Malalignment may lead to premature osteoarthritis, especially as the deformity approaches the ankle or knee.[6,7,8]

The role of fibular fixation in conjunction with intramedullary tibia nailing remains debated among orthopaedic surgeons, especially for distal third tibia and fibula fractures. While some argue against the necessity of fixing the fibula, others suggest that fibula plating enhances rotational stability and alignment, preventing varus and valgus malunion.[9,10,11,12] Current consensus is lacking, necessitating further studies to determine the clinical efficacy and optimal management of combined distal third tibia and fibula fractures. A prospective comparative study is carried out to assess the impact of fixing the fibula before nailing the tibia in distal tibia fractures.

MATERIALS AND METHOD

The prospective study involved 80 patients divided into two groups: 40 with fibula fixation and 40 without. Bony union was assessed clinically and radiologically using the RUST SCORE at 4, 8, 12, and 24 weeks post-surgery. Fracture union and complications were documented, and functional outcomes were compared based on Johner and Wruhs criteria.

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INCLUSION CRITERIA

1. Distal third leg fractures situated 8 cm proximal to the ankle joint for two distal locking bolts.
2. Skeletally mature, patients aged 18–70 years, regardless of gender.
3. Closed and Gustilo Anderson type 1 and 2 fractures.

EXCLUSION CRITERIA

1. Patients with upper-third and middle-third fractures of both legs.
2. Gustilo Anderson type 3 fractures.
3. Fractures of the tibial plafond, Tibial segment fractures, Pathological fractures.
4. Conditions precluding major surgical procedures due to comorbidities.

METHODOLOGY

Pre-Operative Assessment:

- X-ray of the fractured leg, including the ipsilateral Knee and Ankle Joints.
- Two views, Anteroposterior and Lateral Views taken.
- Clinically measure nail length from the tibial tuberosity to the medial malleoli of the opposite leg.

OPERATIVE PROCEDURE

In the technique of interlocking nailing for the tibia, the patient is positioned supine on the fracture table, with the limb hanging freely. A 5 cm longitudinal incision is made between the inferior pole of the patella and the tibial tuberosity. The patellar tendon is split or retracted, and a solid curved bone awl is inserted 3mm medial to the tibial crest in the frontal plane. A guide wire is passed into the medullary canal under fluoroscopic guidance, ensuring it reaches the distal metaphysis while maintaining fracture reduction. A cannulated flexible reamer is used, and a nail of appropriate length and diameter is inserted over the guide wire. Proximal locking screws are placed, and 'perfect circles' for distal locking are created using fluoroscopy. Distal locking screws are inserted through small incisions, ensuring proper placement.

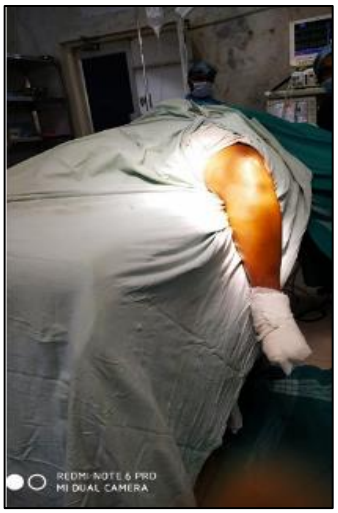

FIG 1- POSITION OF LIMB

FIG 2- INCISION

For fibula fixation, a straight 10 cm incision is made along the shaft of the lower third, exposing the fracture site. After reduction, the fibula is fixed with an adequately sized plate.

FIG -3 INTRA OP PICTURE OF FIBULA PLATING

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POSTOPERATIVE PROTOCOL

- Static quadriceps strengthening exercises and ankle movements started on day 1.
- Knee range of motion exercises began once pain decreased.
- Suture removal done on the 14th postoperative day.
- Non-weight-bearing walker-assisted ambulation is maintained until six weeks.
- Partial weight-bearing started after callus formation is visible on X-rays (6 weeks to 3 months), progressed to full weight-bearing upon radiological union of three cortices.

After six months, the ankle range of motion is assessed using the "Ankle-Evaluation Rating System" by Merchant and Deitz. The final analysis utilises Johner & Wruhs Criteria to evaluate overall functional outcomes.

RESULT

Eighty patients between 18 to 70 years were included in the study with an average age of 42.7 years. In our study, 51 patients (63.75%) were male and 29 patients (36.25%) were female. Right side fracture predominance was seen, accounting for 62.5% cases. There were 76.25% cases with close fracture, and 23.75% cases were open fracture. In all cases, whether the fibula is fixed or not valgus, angulation usually occurs. Deformities of tibia averaged 3.25° in patients with fixed fibula, and 4.36° in patients without fibula fixation as shown in table 1. All fractures united by 12 months, in patients with fibula fixation, mean duration of union was 6.12 months, while patients without fibula fixation had a mean duration of 5.86 months.

Table 1: Post operative valgus angulation.

Valgus Angulation in degree	Fibula Fixed	Fibula Not Fixed	P value
≤1	11 (27.5%)	0 (0%)	0.008
2-5	24 (60%)	32 (80%)	
6-10	5 (12.5%)	8 (20%)	
>10	0 (0%)	0 (0%)	
Mean ± SD	3.25±1.86	4.36±1.78	

Patients with fibula fixation had a mean range of motion of 78.68%, and those without fibula fixation had a mean range of motion of 76.25% as shown in table 2. At the end of 6 months, ankle function was evaluated clinically using Merchant and Dietz criteria. In group 1, mean AERS is 83.10, while in group 2, mean AERS is 84.90. One patient in group 1 and five patients in group 2 had superficial infection, resolved with antibiotics.

Table 2: Post operative range of motion of ankle at 6 months.

ROM (On healthy side)	Fibula Fixed	Fibula Not Fixed
<50	0 (0%)	0 (0%)
50-75	20 (25%)	20 (25%)
76-99	12 (15%)	20 (25%)
100	8(10%)	0(0%)

FIG 4: X-RAY EVALUATION WITH FIBULA FIXATION

Fig 4.a. Pre-op. **Fig 4.b. Post-op.** **Fig 4.c. 4 Months** **Fig 4.d. 12 Months**

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FIG 5- ASSESSMENT OF RANGE OF MOVEMENT

FIG 6- RADIOLOGICAL FOLLOW UP X-RAYS (without fibula fixation)

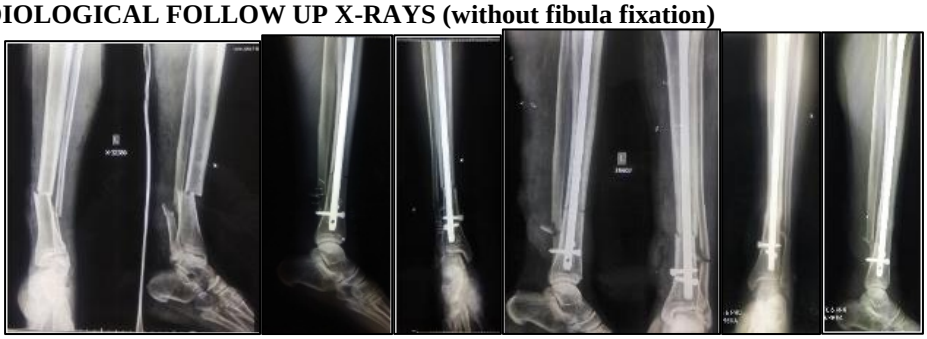

Fig 6.a. Pre-op. Fig 6.b. Post -op. Fig 6.c. 3 Months Fig 6.d. 6 months

FIG 7- ASSESSMENT OF RANGE OF MOVEMENT(without fibula fixation)

DISCUSSION

Distal third leg fractures, resulting from high-energy trauma or low-energy torsional injuries, pose challenges due to limited soft tissue, subcutaneous location, and restricted surgical options. Fibula fixation, while theoretically beneficial for limb length control and anatomical alignment, may lead to delayed union and non-union by inhibiting cyclic loading on the tibial fracture site.[13]

Bonnevialle et al.[14] emphasised the notion that fibular and tibial fractures should be regarded as a unified biomechanical and pathological entity, advocating for double surgical fixation as a supportive measure for tibial reduction and stability. **Mosheiff et al. and Nork et al.**[15] suggested a step-by-step procedure that would fix the fibula before tibial nailing with the goal of reducing the length of the bone and correcting the tibia's frontal-sagittal and rotational aspects. An analysis involving 80 patients was carried out to further explore these principles by comparing the results of fibula fixation and unfixed fibula cases in fractures of the lower third of the tibia and fibula. For all cases of tibial fractures, interlocking intramedullary nails were utilised consistently.

In the study by **Kenneth et al**[12], group 1 (fibula stabilised) had a mean age of 41.6 years and was made up of 6 females and 18 males. Group 2 consisted of 16 female and 31 male participants with a mean age of 43.1 years, in which the fibula was not fixed. The participants in our study ranged in age from 18 to 70, with a combined average age of 41.3 years. We observed a predominance of fractures on the right side, aligning with findings in the study by **Labronic et al**[16].

Regardless of fibula fixation status, all cases underwent valgus angulation, which could be attributed to the larger diameter of the medullary canal in the lower fragment. Furthermore, the short distal tibial segment or misplacement of the guide wire may contribute to deviation from the central and perpendicular positioning in the medullary canal, resulting in valgus/varus angulation. Our findings are comparable with other studies in literature as shown in table 3.

STUDIES	Degree of Valgus Angle	
	Fibula with fixation	Fibula without fixation
Prasad et al[13]	7.73	**10.6**
Morin M et all[22]	6.7	7.4
Janak et al[18]	6.69	9.05
OUR STUDY	3.25	4.36

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A notable difference was identified between patients with fixed and unfixed fibula in terms of tibial valgus deformity (P=0.008, indicating significance). Fixation of the fibula demonstrated a considerable reduction in valgus angulation. The length of a lateral column is influenced by fibula fixation, and fixing the fibula before tibial nailing proves beneficial in realigning the proximal and distal tibial fragments.[10]

In the investigation by **Devatheya et al**[17], The fibula-fixed group demonstrated a recorded range of motion (ROM) of 67.25%, whereas the non-fixed group showed a ROM of 67.35%. **Prasad et al**[13] reported that in group A, 73.3% of patients exhibited good ROM, and 26.7% had fair ROM, while in group B, 66.67% had good ROM and 33.33% had fair ROM.

Our study found that the ankle range of motion of patients with and without fibula fixation was statistically similar (p>0.05), with a mean ROM of 76.25% in the group without fibula fixation and 78.67% in the group with fibula fixation.

Referring to **Merchant and Deitz et al**[5] clinical trial involving 37 patients followed up for 29 years, where non-operative treatment was applied with casts for distal third tibia shaft fractures, our study found a mean ankle evaluation score of 84.47 for patients with fibular fixation and 82.90 for those without fibular fixation. The ankle evaluation scores were statistically similar for both groups.

In the study by **Janak et al**[18], patients with a fixed fibula showed a mean union time of 5.47 months, whereas those without a fixed fibula had a slightly shorter mean union time of 5.28 months. **Jeffrey et al**[19] reported that fibula fixation did not have a significant impact on the time of union, with all fractures achieving union within an acceptable time frame. In **Prasad et al**[13] study, In the group that had fibula fixation, the mean time of union was 4.93 months; in the group that did not, it was 5 months. In our investigation, patients with a fixed fibula had a mean union time of 6.02 months, while those without fibula fixation had a mean union time of 5.92 months (p=0.68).

Varsalona and Liu[20] concluded that improper reduction and fixation of the fibula may lead to additional soft tissue damage and an increased incidence of late malunion. **Marsh et al.**[21] suggested that the fibular fixation method is associated with a higher risk of infection. In our study, 5 cases in the group with fibula fixation experienced superficial infections, compared to 1 case in the group without fibula fixation. Infections were managed with regular dressing and antibiotics.

CONCLUSIONS

In conclusion, fibula fixation alongside intramedullary tibial nailing in distal tibia fractures exhibited subtle benefits in terms of deformity reduction and ankle function. However, the difference in union duration was marginal, prompting a careful consideration of individual patient factors. This study contributes valuable insights into the ongoing debate surrounding the optimal management of distal tibia and fibula fractures, emphasising the need for further research and consensus-building in this complex orthopaedic scenario.

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