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## A Study of functional and radiological outcome of distal third both bone leg fractures with or without fibula fixation as an adjuvant to intramedullary nailing

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### Abstract

The purpose of this study is to assess fibula fixation in distal both bone leg fractures in terms of stability to fracture reduction and to assess the Radiological union and Functional outcome, complications in patient treated with and without fibula fixation.

This prospective study is done from Oct 2017 to May 2019 having 60 patients, 30 patients with fibula fixation and 30 patients without fibula fixation done in department of orthopaedics of Victoria and Bowring & Lady Curzon hospitals, Bangalore.

These cases were reviewed periodically at 4, 8, 12 weeks and 24 weeks both clinically and radiologically for bony union. Clinical outcome and Radiological criteria (RUST SCORE) regarding fracture union and complications was evaluated and documented. Functional outcome was compared with Johner and Wruhs criteria.

Fixation of fibula in cases of distal third fractures of both bones of leg where tibial fracture is treated by IM nail have better outcomes by significantly reducing tibial malalignment (varus/valgus). Fibula fixation prior to fixation of tibia helps in restoring the height of the lateral column and helps in reduction of the tibia anatomically and also radiological shortening post operatively was less. This may be the reason for less valgus/varus angulation in cases where fibula was fixed.

There is no significant difference in the time of union of the tibial fracture, radiological translation, rate of complications and the functional score between the two groups of patients.

**Keywords:** Septic arthritis, hip joint, children

### Introduction

Tibial Diaphyseal Fractures are one of the most common long bone fracture encountered [1, 2]. Distal third region accounts to about 37% of all tibia shaft fracture [1, 3, 4]. As the shaft of the tibia is subcutaneous throughout its length and may have a diminished blood supply, severe complications and major disability are common outcomes [5].

Fractures at the distal end of the tibia have been shown to have higher rates of complications of non-union, malunion, and malalignment due to its wider intramedullary canal. Malalignment of tibial fractures is still a concern as the location of the deformity approaches the ankle or the knee, malalignment results in maldistribution of articular surface pressures that may predispose a patient to premature osteoarthritis [6, 7, 8]. For a combined distal tibia and fibula fracture, there exists as debate among surgeons as to whether fix or not as an adjuvant to IM nailing. The role of fibula in maintaining stability after fixation of distal tibia fracture has not been clearly defined [9, 10, 11].

Presently, there is no clear consensus on the optimum management of combined distal third tibia and fibula fractures. So further studies on clinical efficacy of this technique are needed.

### Objectives

- To assess fibula fixation in distal both bone leg fractures in terms of stability to fracture reduction.
- To assess the Complications like Varus/valgus, non-union, malunion in patient treated with and without fibula fixation
- To assess Radiological union and Functional outcome

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## Materials and Methods

This study is a prospective study done from Oct 2017 to May 2019 having 60 patients, 30 patients with fibula fixation and 30 patients without fibula fixation who are fulfilling the inclusion criteria done in department of orthopaedics of Victoria and Bowring & Lady Curzon hospitals, Bangalore.

### Inclusion Criteria

1. Patients willing to give informed consent.
2. Patients with fracture of both bone of the leg distally and 10 cm proximal to ankle joint so that two distal locking bolts can be put.
3. Age of patients from 20-50 years of either sex.
4. Closed and Gustilo Anderson type 1 and 2.
5. Patients who have attained skeletal maturity when assessed radiographically.

### Exclusion Criteria

1. Patients with upper one third and middle one third fractures of the both bones of the leg.
2. Compound Grade III fractures.
3. Fractures involving distal tibial articular surface.
4. Segmental fractures of the tibia.
5. Pathological fracture.
6. Comorbid conditions not permitting major surgical procedures.
7. Uncooperative patients (mentally ill) and patients not willing for surgery.
8. Patient not willing for surgery.
9. Patient not willing for informed consent

### Methodology

Patients of Victoria Hospital and Bowring & Lady Curzon hospital with distal 3<sup>rd</sup> Both bone leg fractures who fulfill the inclusion & exclusion criteria were taken into the study after obtaining informed written consent. Demographic data, History, Clinical examination and details of investigations were recorded in the study Proforma. Out of 60 patients, in all cases, tibia fracture was fixed with IM nail and for fibula, 30 cases were fixed with 1/3<sup>rd</sup> tubular plate / rush pin. These cases were reviewed periodically at 4, 8, 12 weeks and 24 weeks both clinically and radiologically for bony union. Clinical outcome and Radiological criteria (RUST SCORE) regarding fracture union and complications was evaluated and documented. Functional outcome was compared with Johner and Wruhs criteria.

### Follow-up

Non-Weight bearing for 6 weeks; Partial Weight bearing started when there is evidence of callus formation (6 weeks to 3 months) and Full weight bearing started when there is radiological union of 3 cortices).

Postoperatively Patients were followed up Clinically and Radiologically at 6 wks, 3 months, and 6 months & 1 year and then yearly intervals until the fracture healed completely. At the end of 6 month, the range of movement [dorsiflexion and plantar flexion] at the ankle was determined. Functional assessment of ankle function is done by "Ankle-Evaluation Rating System" by Merchant and Deitz. "Johner & Wruhs' Criteria" was used for final evaluation.

### Results

In our study, age incidence ranged from 18 to 70 yr. with a combined average age of 41. 3yr. Maximum incidence of age in

both groups is between 41 to 50 yr, that is 40% in group 1 and 43.3% in group 2.

In our study 81.7% were male and 18.3% were female. In group 1 twenty-three were male and seven were female while in group 2 twenty-six were male and four were female.

Predominant side of fracture was right involving 58.3% cases and 41.7% were left.

### Type of fracture

In our study 76.7% of cases were closed fractures and 23.3% were open fractures. In the first group with no fibula fixation 19(63.3%) were closed fractures. Among the patients with fibula fixed 27(90%) were closed fracture and 3(10%) were open fracture. In the group with fibula fixation, one patient had type I and two had type II open fracture. In the group without fibula fixation 7 were type I and 4 patients had type II open fracture.

**Table 1:** Type of fracture

Type of fracture	Fibula Fixation		Total (n=60)	P value
	Fibula Not Fixed (n=30)	Fibula Fixed (n=30)		
Closed	19(63.3%)	27(90%)	46(76.7%)	0.015*
Open	11(36.7%)	3(10%)	14(23.3%)	
Type				
Nil	19(63.3%)	27(90%)	46(76.7%)	0.045*
1	7(23.3%)	1(3.3%)	8(13.3%)	
2	4(13.3%)	2(6.7%)	6(10%)	

### Assessment of radiological angulation

In the study 70% were having good valgus score in which twenty-four case were from group 1 and 18 from group 2. In group 2 eight cases were having excellent valgus score (<1). With mean valgus score of 4.49 in group 1 and 3.55 in group 2

**Table 2:** Assessment of radiological angulation

Valgus	Fibula Fixation		Total
	Fibula Not Fixed	Fibula Fixed	
≤1	0(0%)	8(26.7%)	8(13.3%)
2-5	24(80%)	18(60%)	42(70%)
6-10	6(20%)	4(13.3%)	10(16.7%)
>10	0(0%)	0(0%)	0(0%)
Total	30(100%)	30(100%)	60(100%)
Mean ± SD	4.49±1.78	3.55±1.86	4.02±1.86

P=0.051+

### Time of union

73.3% cases were united in a period of 3-6 months and 23.3% in 6-9 months. In group 2 two cases (6.7%) were having union in 9-12 months

**Table 3:** Time of union

Time to union	Fibula Fixation		Total
	Fibula Not Fixed	Fibula Fixed	
<3	0(0%)	0(0%)	0(0%)
3-6	23(76.7%)	21(70%)	44(73.3%)
6-9	7(23.3%)	7(23.3%)	14(23.3%)
9-12	0(0%)	2(6.7%)	2(3.3%)
More than 12	0(0%)	0(0%)	0(0%)
Total	30(100%)	30(100%)	60(100%)

P=0.554, Not Significant

### Ankle Evaluation Rating System

Clinical assessment of ankle function according to the criteria of Merchant and Dietz at the end of 6 months. Mean AERS in

group 1 is 82.90 points and in group 2 is 84.7.

**Table 4:** Ankle evaluation rating system

AERS	Fibula Fixation		Total
	Fibula Not Fixed	Fibula Fixed	
<50	0(0%)	0(0%)	0(0%)
50-75	6(20%)	5(16.7%)	11(18.3%)
76-99	24(80%)	23(76.7%)	47(78.3%)
100	0(0%)	2(6.7%)	2(3.3%)
Total	30(100%)	30(100%)	60(100%)

P=0.582

#### Radiological shortening immediate post operatively

In our study 79.7% have less than 2 mm shortening, in 28 cases from group 2. Three cases in group 1 have shortening between

6-8 mm and 1 case having 8 mm with mean shortening of 2.09 mm.

**Table 5:** Radiological shortening

Variables RAD Shortening	Fibula Fixation		Total (n=59)
	Fibula Not Fixed (n=30)	Fibula Fixed (n=29)	
0-2	19(63.3%)	28(96.6%)	47(79.7%)
2-4	5(16.7%)	0(0%)	5(8.5%)
4-6	2(6.7%)	1(3.4%)	3(5.1%)
6-8	3(10%)	0(0%)	3(5.1%)
8-10	1(3.3%)	0(0%)	1(1.7%)

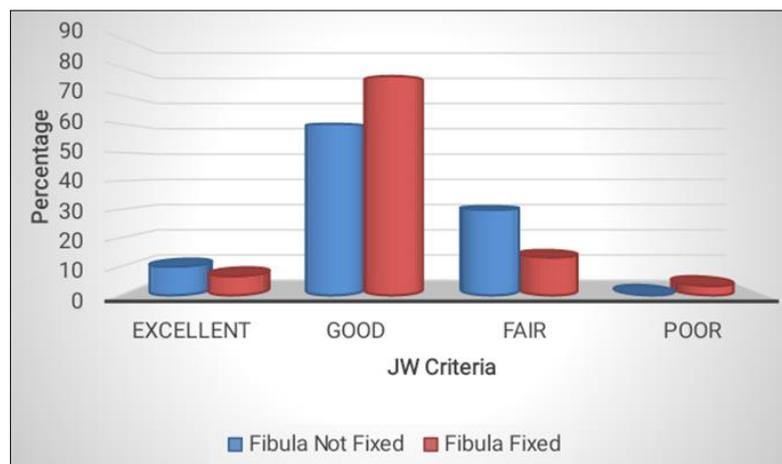
#### Follow up duration

Minimum follow up of 5 month and maximum was of 19 months with mean duration of follow up 10.3 months

outcome in that 18 were from group 1(not fixed) and 23 were from group 2(fibula fixed). In five patient's functional outcomes were excellent. Statistically functional outcome by JW Criteria was similar in both groups

#### Johner AND Wruh's Criteria

Out of 60 patients forty-one patients have good functional



**Fig 1:** Johner and Wruh's criteria

#### Discussion

Patients of Victoria Hospital and Bowring & Lady Curzon hospital with distal 3<sup>rd</sup> Both bone leg fractures who fulfill the inclusion & exclusion criteria were taken into the study after obtaining informed written consent. All the patients were treated with interlocking nailing of the tibia. The patients were grouped into two groups based on whether fibula was fixed or not. Following discharge, the patients were followed up at regular intervals. During follow up they were assessed clinically and radiologically for angulation at the fracture site, fracture union and functional score.

Patients age ranged from 18 to 70 years with mean average age is 41.3yrs. 81.7% were male and 18.3% were female. Predominantly Right side of limb is involved having 58.3%

cases and 41.7% were left. 76.7% of cases were closed fractures and 23.3% were open fracture. In study 33.3% were simple transverse fracture (A3) followed by bending wedge fracture (B2) involving 25% cases.

70% patients were having good valgus score in which twenty-four case were from group 1 and eighteen from group 2. In group 2 eight cases were having excellent valgus score (<1). In our study the average valgus deformity of the tibia in patients in whom fibula was fixed was 3.35 degree and those in whom fibula was not fixed was 4.49 degree (P=0.051+, Significant).

The average valgus angulation was significantly less 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 [16]. The same has been established in other studies as shown below.

**Table 5:** Valgus Angle

Studies	Valgus Angle (Degree)	
	Fibula Fixed	Fibula not Fixed
Prasad <i>et al.</i> [12]	7.73	10.6
Tailor <i>et al.</i> [13]	6.69	9.05
Morin M <i>et al.</i> [14]	6.7	7.4
Our Study	3.35	4.49

Range of movements at the ankle at the end did not show any statistically significant difference between the two groups. The mean range of movements in patients with fibula fixation was 77.97% and that in whom fibula is not fixed was 76.56%.

The Ankle-Evaluation score assessed follow up was statistically similar between the two groups in whom fibula was fixed or not fixed. Mean AERS in group 1 is 82.90 points and in group 2 is 84.7.

Mean AERS score in other studies is as follows

**Table 6:** Mean AERS

Studies	Mean Aers
Janak <i>et al.</i> [13]	64. 25
Sarathy <i>et al.</i> [15]	73. 26
Merchant and dietz <i>et al.</i> [4]	88. 4
Our study	83. 68

The mean time of union of the fracture was statistically similar in the two groups. Mean time of union in patients with fibula was fixed were 6.02 months and those in which fibula was not fixed was 5.92-month Complications were comparatively higher in the group with fibula fixed. 79.9% patients were having <2 mm radiological shortening post operatively.

Three cases in which the fibula was not fixed were having shortening between 6-8 mm. one case had 8mm of shortening. Radiological shortening in both groups was found statistically insignificant.

According to Johner and Wruh's criteria, the distribution of results was statistically similar between the two groups.

### Johner and Wruhs Criteria

**Table 7:** Johner and Wruhs Criteria

	Excellent	Good	Fair	Poor
Non-union	None	None	None	Yes
Deformity (Varus/valgus)	None	2-5'	6-10'	>10'
Mobility at Ankle (%)	Normal	>75 %	50-75%	< 50%
Gait	Normal	Normal	Insignificant limp	Significant limp

### Ankle evaluation and rating system by merchant & deitz: (100 point scale)

10 POINTS: Motion at Ankle

40 POINTS: Function

40 POINTS: Pain

10 POINTS: Gait

**Table 7:** AERS

Points	Questions	
Functions	Does housework or job without difficulty Climbs stair	8
	Foot over food	6
	Any manner	4
	Carries heavy objects, such as suitcase	4
	Can run, participate in athletics work at heavy labour	4
	Walk enough to b independent	8
	Does yard work, gardening, lawn mowing	4
	Has no difficulty in or out of an automobile?	6
Freedom of pain	No pain	40
	Pain only with fatigue or prolonged case	30
	Pain with weight bearing	20
	Pain with motion	10
	Pain with rest or continues pain	0
Gait	No limp	10
	Antalgic limp	8
	uses cane or one crutch	2
	Uses wheelchair or can't walk	0
	Total amount of dorsiflexion and plantar flexion, assign 2 point for every 20 degree	10

### Range of Motion Analysis of Ankle Joint

Poor :< 50%

Fair: 50 to 75%

Good: 75 to 99%

Excellent: 100% motion

### Limitations of the Study

1. The two groups were small, which decreases the power to detect the possible real differences that might exist between those with and without fibular fixation
2. Co morbidities of the patients were not considered.
3. The duration of follow up is less when compared to other studies, Average duration in our study is 10.3 months.

### Conclusions

Fixation of fibula in cases of distal third fractures of both bones of leg where tibial fracture is treated by IM nail have better outcomes by significantly reducing tibial malalignment (varus/valgus). Fibula fixation prior to fixation of tibia helps in restoring the height of the lateral column and helps in reduction of the tibia anatomically. This may be the reason for less valgus/varus angulation in cases where fibula was fixed.

There is no significant difference in the time of union of the tibial fracture between the two groups of patients. Radiological shortening post operatively is less in group B in which fibula was fixed. There is no significant radiological translation between the two groups. There was no significant difference in

the rate of complications between the two groups. The functional score between patients with and without fibula fixation were statistically similar

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