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Original Research Paper

Orthopaedics

ASSESSMENT OF OUTCOME IN CASES WITH EXTRAARTICULAR DISTAL THIRD TIBIA FIBULA FRACTURES TREATED WITH INTERLOCKING NAILING OF TIBIA WITH CONCOMITANT FIBULAR FIXATION BY ORIF WITH PLATE OR BY CLOSED NAILING

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ABSTRACT

BACKGROUND- The present study aimed to assess and compare the radiological and functional outcome, union time and complications in cases of extraarticular distal third Tibia fibula fractures treated with interlocking nailing of Tibia with concomitant Fibular fixation either by ORIF with plate or by closed nailing.

METHODOLOGY- This was observational prospective study which was carried out at Department of Orthopedics in Unique Super Speciality Centre, Indore (M.P.) for a period of 1 year on adults belonging to age group between 18 to 75 years of either gender. All the cases were randomly allocated in two groups. During surgery, fracture tibia was managed with the help of interlocking intramedullay nail in all the cases in both the groups whereas fibular fracture in group A were managed using ORIF with semitubular plate or reconstruction plate and that in group B was managed using CRIF with rush nail/ square nail/ k wire.

RESULTS-There was no statistically significant association between the complications and the groups ($p>0.05$), showing that the complications is independent of the groups. There was a significant improvement in the score at 3 months and 6 months ($p<0.05$) in both the groups; however, no statistically significant difference in union time between the two groups ($p>0.05$). Also no statistically significant association between the outcome and the groups ($p>0.05$) was observed.

CONCLUSION- The choice of fixation for adjunctive stabilization of fibula has no effect on the fracture tibia union and the ultimate functional outcome. Closed nailing is better where the soft tissue morbidity is high (as in high velocity trauma and open fractures) and where bones are weak (elderly patients). Other immunocompromised states such as diabetes in which there are higher infection rates with traditional plating techniques.

KEYWORDS : Tibia fracture, ORIF with plate, CRIF with wire, union time, complications.

INTRODUCTION

With global increase in incidence of road traffic accidents, the number of deaths in major road traffic accidents has reached 1.35 million per year while approximately 20 to 50 million more people suffer non-fatal injuries.[1] WHO estimates that approximately 90% of the RTA deaths occur in low- and middle-income countries, even though these countries have approximately 60% of the world's vehicles.[1] In India, 1.38 lakhs fatalities (85% Males, 15% Females) were reported due to road traffic accident every year according to WHO global safety report 2015.[2]

Tibial shaft fractures are one of the most common long bone diaphyseal fractures.[3,4] Distal third tibia fractures are different, in that the bone is entirely subcutaneous without muscle covering on its anteromedial aspect and consequently the blood supply to the tibia is less. As compared to other long bones, there may be delayed union or non-union due to this precarious vascularity. Considering the anatomy of lower third of tibia, treatment of lower third tibia fracture remains a major substantial therapeutic challenge in orthopedic trauma because it is difficult to achieve reduction and maintain it owing to wide metaphysis, poor skin condition, and fracture comminution.[5] When a fibular fracture is found at the same level as the tibia, reduction is even more difficult. This fracture pattern usually occurs due to high-energy mechanism of trauma causing an increased angular and rotational instability, limb shortening and soft tissue injuries.[5,6] As malalignment of healed tibial shaft fracture may result in post traumatic arthritis of knee or ankle, this fracture and its surgical correction is of considerale importance.[7-10] The location of the mal-union is important, with distal deformities more likely to be symptomatic.[7,11,12]

Various treatment have been described for distal third tibia fractures in literature.[16,17] Out of these, two most used techniques are: intramedullary locking nail and minimally-invasive bridge plate. Intramedullary nailing is indicated for the majority of closed lower third tibia and middle and lower third junction fractures of the tibia as well as for open fractures with adequate soft tissue cover when fracture is not extending into the lower 4 cm of tibia from the ankle joint.[13,14]

The clinical impact of concomitant fixation of fibula along with intramedullary tibia nail in distal third tibia fibula fractures is still controversial. Some authors believe that fibular fixation would help to reduce rotational and sagital instability, which may be difficult to achieve with intramedullary tibia nail alone. Fibular fixation would help to restore length and angular and rotational deformities, thus reducing the risk of vicious union.[5,6,17,18] Few studies suggest that in treatment of fracture distal third of tibia and fibula, the Fibular fracture should be fixed as it confers rotational stability to distal Tibial fractures treated with intramedullary nailing.[6] Fibula can be fixed by closed nailing or ORIF with plate fixation. Both these modalities have their own indications, advantages and disadvantages.

With this concept in mind, the present study was conducted in management of extraarticular distal third tibia fibula fractures, where the tibia was fixed by locked intramedullary nailing and fibula was fixed either by closed intramedullary nailing or open reduction internal fixation with plate and results were compared on the basis of axial alignment, radiological union, complication rate and functional outcome.

OBJECTIVE-

1. To evaluate and compare the radiological and functional outcome in cases of extraarticular distal third Tibia fibula fractures treated with interlocking nailing of Tibia with concomitant Fibular fixation either by ORIF with plate or by closed nailing.
2. To assess the union time as well as complications between two groups.
3. To assess the union of Tibia in the two groups.

METHODOLOGY

The present study was designed as an observational prospective study which was carried out at Department of Orthopedics in Unique Super Speciality Centre, Indore (M.P.) for a period of 1 year i.e. 21/05/2017 to 20/05/2018 (including 6

months follow up) on adults belonging to age group between 18 to 75 years of either gender. The inclusion criteria was patients who sustained extrarticular distal third tibia –fibula fractures from 4cms – 11cms above the tibial plafond; patients with fresh extrarticular distal third tibia –fibula fractures; patients who attained skeletal maturity when assessed radiographically; patients with closed and Gustilo type I and type II open fractures. However, patients with upper one third and middle one third fractures of the both bones of the leg; with Segmental fractures of the tibia; with intra-articular extension of fractures where interlocking nailing of the tibia was not feasible; with Gustilo type III open fractures or patient who did not attain skeletal maturity when assessed radiologically were excluded from the study, patients failing for follow up.

During the study period of 1 year, initially 40 patients with extraarticular distal third Tibia Fibula fracture brought in our institute and treated with tibia IMN and concomitant fibula fixation selected based upon inclusion criteria. Of them,1 patient failed to come for follow up and so was excluded from the study.

All patients were subjected to detailed history and clinical examination. X-ray of the involved leg full length with knee and ankle AP and Lateral view was conducted for all the patients. Past history of any infection in the body was taken. Patients were also enquired whether any kind of anti-coagulant therapy was going on for previous thrombo-embolic disorder. Initially all the patients were treated with above knee POP slab in involved limb till surgery. Analgesics was given to relieve pain. Routine blood examination along with bleeding time clotting time and urine examinations were also conducted. Special investigations such as ECG, Chest X –ray PA view and 2D Echo were conducted when advised by physician/anaesthetist.

Physician fitness as well as pre-anaesthetic check up of all the patients was done before surgery. X-ray were reviewed again and classified with using Orthopaedic Trauma Association (OTA) classification. Open fractures were classified according to the criteria of Gustilo and Anderson.

All the cases were randomly allocated in two groups. Written consent for surgery was taken from patients and relatives. Xylocaine sensitivity test was done in all the patients. Prophylactic Antibiotics were given during pre-operative period. During surgery, fracture tibia was managed with the help of interlocking intramedullay nail in all the cases in both the groups whereas fibular fracture in group A were managed using ORIF with semitubular plate or reconstruction plate and that in group B was managed using CRIF with rush nail/ square nail/ k wire.

Post operatively, limbs of patients were elevated on pillow and patients kept under observation in recovery room until stable then shifted to ward. Intravenous antibiotics and analgesics were continued for first 48 hours and then it was shifted to oral. Check X rays AP and Lateral view of involved leg including both knee and ankle joint were taken on next postoperative day. Bed side sitting and if tolerated non weight bearing walk with the help of walker was started on 1st post operative day. Static quadriceps exercises and Ankle pumping exercises were started on the first postoperative day. Active quadriceps and hip flexion exercise were started on 6th and 7th post-operative day. Dressing was done on 2nd, 5th and 8th post-operative day. Oral Calcium (500 mg) and Vitamin D (60000 IU weekly) was given for at least 3 months or till radiological fracture union, whichever is longer in all the patients. Sutures, if healthy were removed on 12th post-operative day. Partial weight bearing walking was started at about 4 weeks post operatively. All patients were assessed by using the Ankle – Evaluation Rating System" by Merchant and Deitz[20] at 1, 3 and 6 months follow-up post operatively. The final results were evaluated using the 'Johner & Wruh's Criteria[21]" as excellent, good, fair and poor at the end of 6 month.

STATISTICAL ANALYSIS-

Data was compiled using Microsoft excel and analysed using IBM SPSS software version 20. The mean comparison at two different time intervals was done using paired 't' test, mean comparison between two groups was done during unpaired 't' test, association between two non-parametric variables was done using Pearson chi-square test and comparison of mean of more than two groups was done using one-way ANOVA, followed by post-hoc tukey test. A p value of <0.05 was taken as statistically significant.

Operative Procedure Images

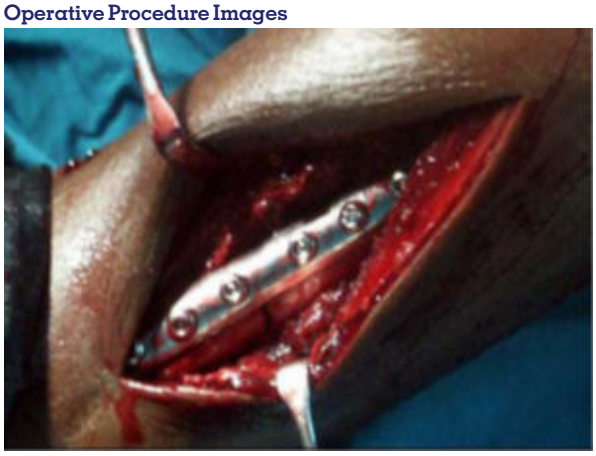
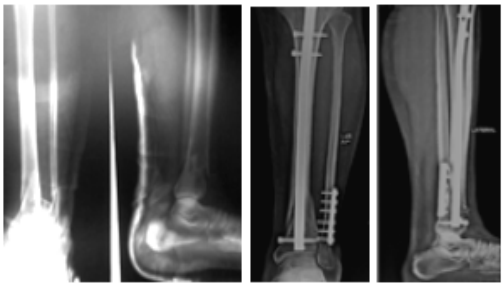


Figure 1 : Intraoperative picture of fibula fixtion with plate

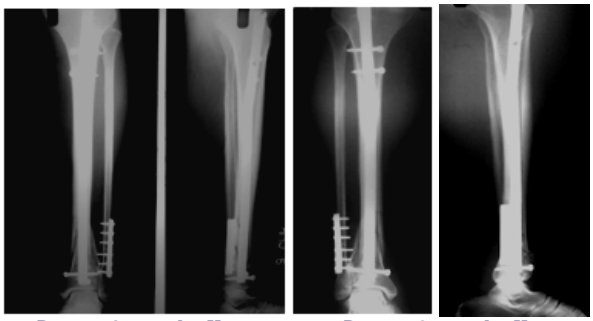
Figure 2 : Intraoperative picture of fibula fixtion with intramedullary nail

Figure 3 : Intraoperative picture of Intramedullary tibia nailing

X-Ray Images

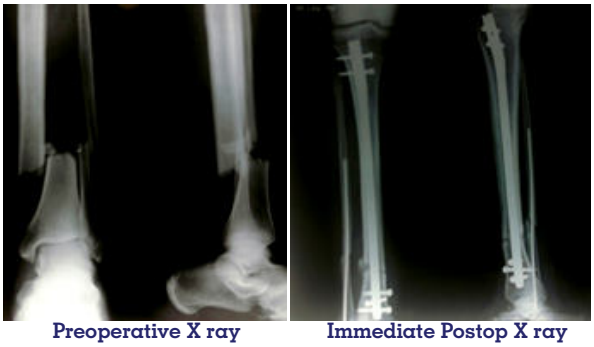


Preoperative X ray **Immediate Postop X ray**



Postop 3 months Xray | Postop 6 months Xray

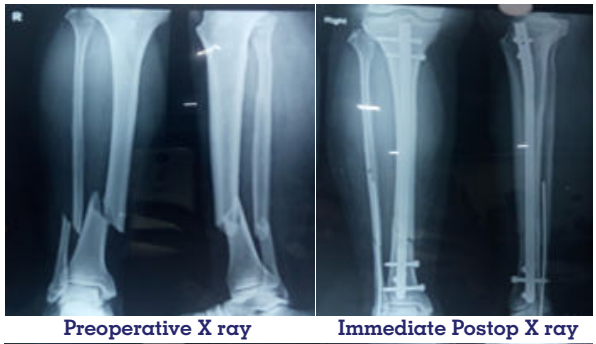
Functional range at 6 months follow up



Preoperative X ray | Immediate Postop X ray

Postop 3 months Xray | Postop 6 months Xray

Functional range at 6 months follow up



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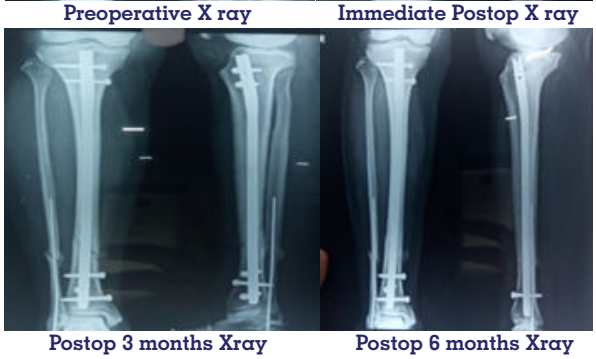

Postop 3 months Xray | Postop 6 months Xray

Functional range at 6 months follow up

RESULTS

The study was conducted on a total of 39 patients with unilateral extraarticular distal third Tibia-Fibula fracture in the age range of 21 to 72 years. Of them tibia intramedullary nailing with concomitant fibula fixation was done by ORIF with plating in 19 patients (Group A) whereas in 20 patients tibia intramedullary nailing along with intramedullary fibula fixation was done (group B).

Table 1- Distribution of patients according to baseline variables

Baseline variables		Group A (n=19)		Group B (n=20)		P value
		No.	%	No.	%	
Age group (years)	21-40	12	63.2	9	45.0	0.28
	41-60	6	31.6	8	40.0	
	>60	1	5.3	3	15.0	
Gender	Female	1	5.3	4	20.0	0.34
	Male	18	94.7	16	80.0	
Mode of Injury	RTA	15	78.9	10	50.0	0.12
	Simple fall	3	15.8	8	40.0	
	Fall from height	1	5.3	2	10.0	
Limb involved	Left	4	21.1	5	25.0	1.0
	Right	15	78.9	15	75.0	

Mean age of patients in group A was 38 ± 12.33 years whereas that of group B was 42.85 ± 14.87 years. Majority of the patients in both the groups were in the age group 21-40 years. About 94.7% and 80% cases in group A and group respectively were males. Most common mode of injury was RTA in both the

groups and right limb was involved in 78.9% and 75% cases in group A and group B respectively. Two groups were comparable in terms of baseline variables (p>0.05).

Table 2- Distribution according to fracture characteristics

		Group A (n=19)		Group B (n=20)		P value
		No.	%	No.	%	
Fracture Classification	43A1	4	21.1	4	20.0	0.77
	43A2	5	26.3	4	20.0	
	43A3	4	21.1	6	30.0	
	43B2	4	21.1	2	10.0	
	43B3	2	10.5	4	20.0	
Radiological pattern	Comminuted	2	10.5	4	20.0	0.78
	Simple Oblique	5	26.3	4	20.0	
	Spiral	4	21.1	4	20.0	
	Simple transverse	4	21.1	6	30.0	
	Wedge	4	21.1	2	10.0	
Type of fracture	Closed	16	84.2	19	95.0	0.27
	Open	3	15.8	1	5.0	

In present study, about 26.3% cases in group A were classified as 43A2 whereas majority i.e. 30% cases in group B were classified as 43A3. Radiological pattern revealed simple oblique in majority (26.3) in group A whereas simple transverse fracture was the most common radiological feature observed in 30% cases in group B. The present study documented no significant difference in fracture characteristics between two groups (p>0.05).

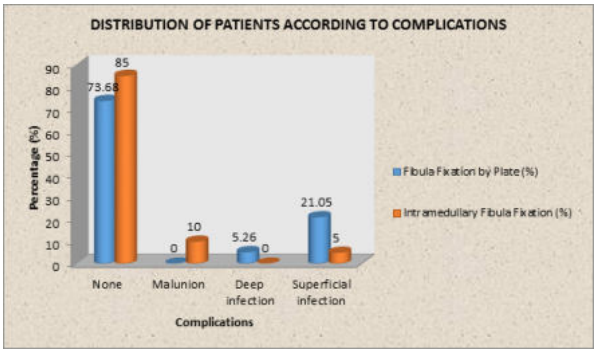

Figure 1- Distribution Of Patients According To Complications

In the group A i.e. fibula fixation by plate group, superficial infection and deep infection was noted in 21.05% and 5.26% respectively. However, in group 2, (Intramedullary Fibula Fixation group), 2 (10%) patient had malunion and 1 (5%) patient had superficial infection. There was no statistically significant association between the complications and the groups (p>0.05), showing that the complications is independent of the groups.

Table 3- Comparison of mean Merchant and Dietz Criteria Score at different time intervals

Time Period	Group A (n=19)			Group B (n=19)		
	[Mean±SD]	't' value	P value	[Mean±SD]	't' value	P value
1 month	20.00 ± 6.73	-10.18,	0.001	18.00 ± 6.02	-7.60,	0.001
3 months	59.26 ± 23.23			48.80 ± 23.89		
3 months	59.26 ± 23.23	-7.80,	0.001	48.80 ± 23.89	-10.00	0.001
6 months	89.26 ± 7.00			84.80 ± 8.74		

The above table shows the distribution of patients according to Merchant and Dietz criteria at different time intervals in both the groups. The mean score in group A at 1 month was 20.00 ± 6.73, while at 3 months it was 59.26 ± 23.23. There was a significant improvement in the score at 3 months in comparison to 1 month (p<0.05). Similarly mean score at 3 months was 59.26 ± 23.23, while at 6 months it was 89.26 ± 7.00. There was a significant improvement in the score at 6 months in comparison to 3 months (p<0.05).

The mean score in group B at 1 month was 18.00 ± 6.02, while at 3 months and 6 months it was 48.80 ± 23.89 and 84.80 ± 8.74 respectively. There was a significant improvement in the score at 3 months and 6 months (p<0.05).

Table 4- Comparison of mean Merchant and Dietz Criteria Score and mean union time at different time intervals between two groups

		Group A (n=19) [Mean±SD]	Group B (n=20) [Mean±SD]	't' value	P value
Time Period	1 month	20.00 ± 6.73	18.00 ± 6.02	0.98	0.334, NS
	3 months	59.3 ± 23.2	48.8 ± 23.9	1.39	0.174, NS
	6 months	89.26 ± 7.00	84.80 ± 8.74	1.75	0.088, NS
Union time (weeks)		17.95 ± 2.34	17.80 ± 2.28	0.20	0.844, NS

The present study observed no statistically significant difference in mean Merchant and Dietz Criteria Score at various time interval between 2 groups (p>0.05). The mean union time in the Fibula Fixation by plate group was 17.95 ± 2.34 weeks and in the Intramedullary Fibula Fixation group was 17.80 ± 2.28 weeks. There was no statistically significant difference in union time between the two groups (p>0.05).

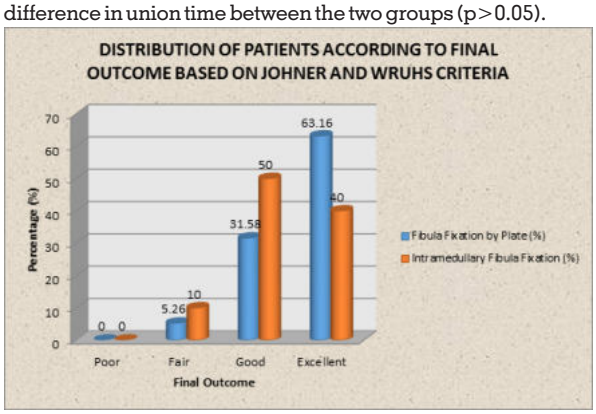

Figure 2- Distribution of patients according to final outcome according to Johner and Wruhs Criteria

In the fibula fixation by plate group (group A), 1 (5.26%) patients had fair outcome, 6 (31.58%) patients had good outcome and 12 (63.16%) patients had excellent outcome. Whereas in the Intramedullary Fibula Fixation group (Group B), 2 (10%) patients had fair outcome, 10 (50.00%) patients had good outcome and 8 (40%) patients had excellent outcome. There was no statistically significant association between the outcome and the groups (p>0.05), showing that the outcome is independent of the groups.

DISCUSSIONS

Extra-articular fractures of distal tibia contribute to approximately 7–10% of all lower extremity fractures and the management of such fractures is variable and controversy exist.[19] In our study, majority of the patients were in the age group of 21-40 years with mean age of 40.48 years. The incidence of distal tibia fractures in males was at the younger age in comparison to females where it was more towards the middle age. These findings were similar to study by Pawar et al[20] where mean age of patients was 41.66 years. In our study male preponderance of tibial fracture was noted in both the groups. Pawar et al[20] also documented similar results of tibia fibula fracture i.e. 90 % males and 10% females.

Majority of the patients in both the groups sustained injury due to RTA (64%). In the fibula fixation by plate group, there were 78.9% patients who sustained injury due to RTA, 15.8% patient sustained injury due to simple fall and 5.3% patients

sustained injury due to fall from height. In the intramedullary fibula fixation, there were 50.0% patients who sustained injury due to RTA, 40.0% patient sustained injury due to simple fall and 10.0% patients sustained injury due to fall from height.

The incidence of the fracture shaft of tibia fibula due to road traffic accidents were also higher in studies done by Prasad et al[21] who reported 90% incidence of Road Traffic Accidents in tibial shaft fractures in their study. Donimath et al[22] in their study found that 88.8% cases were admitted due to RTA. This could be attributed to the poor road traffic sense and also to bad quality roads, in turn leading to higher incidence of road traffic accidents in our country.

Most common fracture pattern was 43A3(25.6%) followed by 43A2(23.1%) and 43A1(20.5%). In the fibula fixation by plate group, 43A2 type was most common (26.3%) while in the intramedullary fibula fixation group, 43A3 type was most common (30.0%). Bonnevialle et al[23] in their study found most common pattern to be A1 (36.4%) followed by A3 (18.9%). Sarathy et al[24] in their study had found most common fracture pattern to be B2(40%) followed by A2(33.3%).

Deformities in the distal third tibia are known to occur in various planes like coronal(varus/valgus), sagittal (recurvatum/ procurvatum) and rotational plane (intorsion/ extorsion). In the Intramedullary Fibula Fixation group, 10.00% patients had malunion in coronal plane with more than 5 degree of valgus angulation and no varus angulation was seen, while there was no sagittal plane or rotational deformity seen in any group. Statistically no significant difference (p value 0.0785) was found in the occurrence of valgus deformity between the two groups. Similar to our study, Bonnevialle et al[23] in their study found that there was reduced coronal plane angular deformities in patients who underwent fibular fixation along with tibial nailing. Prasad et al[21] also found only valgus deformity occurring in the coronal plane and this was significantly more in the group where fibular fixation was not done. The reasons for the deformities occurring in the distal third fractures of tibia 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[25]. In turn this can result in the distal fragment going for sagittal/coronal plane angulation; (2) the short distal tibial segment; (3) the most important factor in avoiding malreduction of distal fragment is ensuring that the guide wire 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 angular deformity[26]. (4) Comminution at the fracture site.

In Fibula Fixation by Plate group, the mean Merchant and Dietz Criteria score at 1 month was 20.00 ± 6.73, at 3 months it was 59.26 ± 23.23 while at 6 months it was 89.26 ± 7.00. Overall there was a significant improvement ($p<0.05$) in the mean score at 6 months. Similarly there was a significant improvement($p<0.05$) in the mean score at 6 months for intermedullary fixation group. However no significant difference was noted between two groups at various time intervals ($p>0.05$). This result is comparable to the study conducted by Prasad et al[21] in their study found a Merchant and Dietz Criteria score at the end of 18 months in the fibular fixation group to be 93.86 and in the non-fixation group to be 90.53. There was no statistical difference between the two groups.

The mean union time in the Fibula Fixation by plate group was 17.95 ± 2.34 weeks and in the Intramedullary Fibula Fixation group was 17.80 ± 2.28 weeks and the difference was statistically insignificant in present study ($p>0.05$). Similar to our study, Prasad et al[21] documented the mean time for union in patients with fibular fixation group and non-fixation group was 4.93 months and 5 months respectively. Sarathy et al[24] in their study found union in all the cases with average union time to be 5 months with minimum of 4 months and a maximum of 7 months. The possible reason for getting a higher average time for union compared to other studies could be: (1) few patients had delayed union which when taken into consideration increased the mean duration of the group, (2) the minimum follow up intervals were fixed at 6 weeks , 3 months, 6 months, 1 year and every 6 months hence. Any union being achieved between the follow up periods cannot be assessed hence giving a false higher reading.

In present study, Association between complications and Fibula Fixation by Plate group and Intramedullary Fibula Fixation group. In the fibula fixation by plate group, 73.68% patients had no complications, 5.26% patient had deep infection and 21.05% patients had superficial infection and no malunion was seen. In the Intramedullary Fibula Fixation group, 85.00% patients had no complications, 10.00% patient had malunion and 5.00% patient had superficial infection. There was no statistically significant ($p>0.05$) between the complications rate in both the groups. Prasad et al[21] had higher rates of complications in the fibular fixation group (superficial infection at the fibular wound site) than the other group. Sarathy et al[24] in their study found wound complications at the Fibular incision site in 13.3% patients.

Johner & Wruh's criteria was used to assess the outcome of the procedure at the end of 6 month follow up period in present study. In the fibula fixation by plate group, outcome was found to be excellent in 63.16% patients as compared to 40% patients in Intramedullary Fibula Fixation group. Though the outcome was slight better in fibula fixation by plate group, there was no statistically significant difference ($p>0.05$) between the outcome in the two groups, showing that the outcome is independent of the method of fixation used. Prasad et al[21] found distribution of final outcome assessed by the Johner and wruh's criteria at the end of 18 months to be similar in both the groups of fibular fixation and non-fixation. Sarathy et al[24]

CONCLUSION

Based upon the finding of present study, tibia interlocking nail is an excellent modality for the treatment of these fractures as it allows early weight bearing with unique fracture impaction and provides axial, angular and rotational stability. There is minimal blood loss. Being a closed method it has minimum chances of infection and utilizes fracture hematoma for early healing. The choice of fixation for adjunctive stabilization of fibula has no effect on the fracture tibia union and the ultimate functional outcome. Closed nailing is better where the soft tissue morbidity is high (as in high velocity trauma and open fractures) and where bones are weak (elderly patients). Other immunocompromised states such as diabetes in which there are higher infection rates with traditional plating techniques.

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