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Effect of intact fibula in treatment of tibail diaphyseal fractures with intramedullary nailing

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Abstract
Introduction: Nonunion rates among the cases with isolated tibial diaphyseal fractures ranges from 1%-17%. Studies can be found, saying that intact fibula is a good prognostic factor and will increase stability, and also which say intact fibula can lead to delayed union in conservative treatment of the tibial diaphyseal fractures.
Material and Methods: This study tries to assess the healing, maintenance of reduction, nonunion rates and compare the outcome of tibial diaphyseal fractures with or without associated fibula fractures. 58 patients with tibial diaphyseal fractures with or without fibula fracture visiting hospital between January 2015 to December 2016 who underwent intermedullary nailing were included in the study.
Results: There was no statistically significant differences between groups in terms of age or follow-up period. Mean time to union was 75 days (range: 60 to 120 days) in the intact fibula group, and 92 days (range: 60 to 180 days) in the group with tibia and fibula fracture. Dynamization was performed due to delayed union in 4 patient in second group. The xrays taken at the final follow up in the first group revealed mean varus angulation of 0.78° (range: 0 to 2°), valgus angulation of 0.09° (range: 0 to 1.1°), antecurvatum angulation of 1.09° (range: 0 to 6°), and recurvatum angulation of 0.15° (range: 0–1.1°). The same values were 1.12° (range: 0 to 4.2°), 0.67° (range: 0 to 3.6°), 0.35° (range: 0 to 2.3°), and 0.86° (range: 0 to 6.7°), respectively, in the second group, which had no significance statistically.
Conclusion: Our study results indicated that intact fibula in tibial diaphysis fractures treated with intramedullary nailing will not affect rate of union, or lead to loss of reduction, non-union, or malunion.

Keywords: Intact fibula, tibial diaphyseal fractures, fibula and stability

1. Introduction
The most common long bone fracture seen is that of tibial diaphysis, most of which are associated with fibula fracture. However isolated tibial fractures are not rare either [1, 2]
Beyond doubt the gold standard for tibial diaphyseal fracture treatment is intermedullary nailing, the treatment of concomitant fibula fracture is largely controversial [3].
Nonunion rates among the cases with isolated tibial diaphyseal fractures ranges from 1%-17 [4]. Majority of the studies blame the intact fibula for the high rate of non-unions among isolated tibial diaphyseal fractures [5, 6]. The aim of our study was to assess the healing, maintenance of reduction, non-union rates and compare both the groups in terms deformity at final follow up.

2. Material and Methods
58 patients with tibial diaphyseal fractures with or without fibula fracture visiting hospital between January 2015 to December 2016 who underwent intramedullary nailing only (patients in whom the fibula fixation was indicated were excluded from the study) were included in the study.
Six patients were lost in the study, four patients did not return after the procedure and two patients had changed the city of residence and hence not available for follow up. Fifty two patients were available for the evaluation. Each patients immediate post-operative xrays were used to record the fracture gap, varus/valgus and antecurvatum/ recurvatum. Each patient was followed up at interval of one year till solid radiological union was achieved. In each follow up fracture gap and deformities were documented. Once the radiological union was achieved deformities were documented again.

The information collected regarding all the selected cases were recorded in a Master Chart. Data analysis was done with the help of computer using Epidemiological Information Package (EPI 2010) developed by Centre for Disease Control, Atlanta. Using this software range, frequencies, percentages, means, standard deviations, Chi-square, *t*-test, and "*P*" values were calculated. *T*-test and ANOVA tests were used to assess the significance of difference between quantitative variables and Yates's and Fisher's Chi-square tests for qualitative variables. A $P<0.05$ was taken to denote significant relationship.

3. Results

In the first group in which the fibula was intact but tibial diaphysis was fractured, consisted of 28 patients (18 male, 10female), and second group, in which both the fibula and the tibial diaphysis were fractured, consisted of 24 patients (16 male, 8 female).

The mean age of the patients was 29.4 years (range: 19 to 60years) in first group, and 38.6 years (range: 18 to 66 years) in second group. Patients in first group had mean follow-up period of 9 months (range: 6months to 18months), whereas in second group patients were followed up for mean of 11 months (range: 9months to 16months). There was no statistically significant differences between groups in terms of age or follow-up period (p=0.751; p=0.400). Mean time to surgery was 5.1 days (range: 2 to 9 days) in first group and 4.1 days (range: 1 to 15 days) in the second group which was statistically not significant (p=0.226).Duration of surgical tourniquet was noted as mean of 102 minutes (range: 60 to 150 minutes) in first group, and 101 minutes (range: 60 to 160 minutes) in second group. Statistically duration of surgery was insignificant (p=0.991). None of the patients in both the groups experienced intraoperative complication or had early or late infection symptom during follow-up period. Non-union was not observed in any patient. Mean time to union was 75 days (range: 60 to 120 days) in first group, and 92 days (range: 60 to 180 days) in second group. Dynamization was performed due to delayed union in 4 patient in second group.

The xrays taken at the final follow up in the first group revealed mean varus angulation of 0.78° (range: 0 to 2°), valgus angulation of 0.09° (range: 0 to 1.1°), antecurvatum angulation of 1.09° (range: 0 to 6°), and recurvate angulation of 0.15° (range: 0–1.1°). The same values were 1.12° (range: 0 to 4.2°), 0.67° (range: 0 to 3.6°), 0.35° (range: 0 to 2.3°), and 0.86° (range: 0 to 6.7°), respectively, in the second group, which had no significance statistically.

Segmental tibia fracture with intact fibula showing union at the end of six months

4. Discussion

There is lot of controversy regarding treatment of extraarticular tibia fractures with intact fibula. Studies can be found that say intact fibula can lead to delayed union in conservative treatment of the tibial diaphysis fracture, as well as the ones which suggest that intact fibula is a good prognostic factor and will increase stability [2, 4, 7].

There are studies which have suggested fixation of fibula fractures in case of extra-articular tibia fracture will increase stability, while others suggest that fixation does not provide an additional benefit and is an unnecessary additional surgical procedure [8, 9, 10].

None of them categorically conclude about the influence of intact or fractured fibula on the outcome of tibial diaphyseal fractures.The study by Gotzen *et al.* [11] reported that fixation of the fibula with plating increased stability. Similarly, the study by Morrison *et al*. [9] concluded that fixation of the fibula with plating increased stability by 2.2 times in axial loading, but did not have an effect on torsional stability [9, 11].

Weber *et al*. [12] created tibia defects in cadavers for a biomechanical study that investigated axial and bending forces. The study recorded increased movement in the defect area following fibular osteotomy and external fixation of the tibial segmental defects; however, encountered no such increase in movement where they treated the tibial defects with intramedullary nail [12].

All the patients in our study were treated with intramedullary nailing and no insufficiency in stability due to movement on the fracture line was observed in either group. In addition, there was no statistically significant difference between the 2 groups in rate of union. It is well known that the fibula bears 3% to 16% of the load in axial loading [13, 14]. It is believed by some that intact or fixed fibula provides additional support to stability in fracture of diaphyseal region of the tibia as recorded by Strauss *et al.* [15] who stated that fibula fracture level with tibia fracture decreased stability of the tibial fixation, and that stability was improved with intact or fixed fibula. In our study, none of the patients in second group (with fractured fibula) suffered non-union or deformity due to insufficient stability. The study by Bonnevialle *et al.* [16]. showed tibia fractures with intact fibula treated using reamed intramedullary nail had fracture gap increase in 5 patients. They performed dynamization on 6 patients due to delayed union and replaced nail in 2 of these 6 patients due to non-

union. None of the patients in the first group (with intact fibula) of the our study experienced either fracture gap increase, delayed union, or non-union. This study, limited by number of cases in both groups, occurrence of tibial fracture outside the proximal and distal metaphyseal regions are shortcomings of our study.

5. Conclusion

In conclusion fixation of the fibula in tibia fracture is still a matter of debate. Our study results indicated that intact fibula in tibial diaphysis fractures treated with intramedullary nailing will not affect rate of union, or lead to loss of reduction, non-union, or malunion.

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