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Functional outcome of the effect of fibular fixation on malaligned fractures of lower third tibia-fibula treated by interlocking nail of the tibia

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Abstract

Background & Objectives: In the treatment of fractures of the distal third of the tibia and fibula treated by interlocking nailing of the tibia, the role of fixing the fibular fracture is not clearly defined. This study was undertaken to assess the benefits of fixation of the fibula clinically, radio graphically and functionally in fractures of the lower third of the leg.

Methods: 18 patients with fractures of the lower third of the leg were followed up for an average of fourteen months. The patients were divided in to two groups based on whether fibula was fixed or not, the fracture tibia being treated with interlocking intramedullary nailing in all the cases. In the follow up the two groups were compared for radiological differences in the angulation at the fracture site, clinical and functional outcome at the end of six months, time of union and complications.

Results: The demographics of the two groups were similar with respect to age, sex, side of fracture, fracture classification and nature of the injury. The average valgus angulation was significantly less in the group where fibula was fixed ($p=0.009$). The outcome of the two groups for clinical ankle score, measured at six months follow up, time of union and complications showed no significant differences.

Interpretation & Conclusion: Fixation of the fibula decreases the malalignment of the tibia in distal third fractures of the tibia and fibula treated with interlocking nailing of the tibia.

Keywords: fracture, tibia, fibula, interlocking nailing, plating

Introduction

Of all the long bones, the tibia has the highest incidence of diaphyseal fractures [1, 2, 15, 17]. Fractures of the tibial shaft are the most common of the long bone fractures. Fractures of the tibial shaft are important for two reasons-first is that they are common; the second that they are controversial and anything that is both common and controversial must be important [2, 8]. Because 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 [1]. Fractures of the tibia and fibula can range from completely undisplaced fractures with minimal soft tissue damage, to traumatic amputations. The treatment modalities described for tibia and fibula fractures range from simple cast immobilization to complex surgical procedures [1].

Considerable concern exists that malalignment of a healed tibial shaft fracture may result in post-traumatic arthritis of the ankle or knee [3, 15-18, 21, 23]. 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 [1, 19, 20, 22, 23]. The location of the mal-union is important, with distal deformities more likely to be symptomatic [3, 20, 22].

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 [18, 29, 31]. To the best of my knowledge no study on the effect of fibular fixation in patients with fractures of the both bones of lower third leg treated with intramedullary nailing of tibia is available in literature. However cadaver study on the effect of fibular plate fixation on rotational stability of simulated distal tibial fractures treated with intramedullary nailing has been done. Cadaver study concluded that fibular plate fixation increased the initial rotational stability with distal tibial fractures compared with intramedullary

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nailing of tibia alone [27]. 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.

Objectives

- Assessment of tibial malalignment clinically and radiographically in patients treated with or without stabilization of fibula in fracture both bones lower one third of the leg with, tibia fixed with interlocking nailing.
- To assess the functional difference in patients in whom fibular fixation was done compared to those in whom fibular fixation was not done.
- To assess the time of union in the two groups.
- To assess the difference in complication rate between the two groups.

Methodology

A study of 36 patients who had fractures of the lower third of tibia and fibula was undertaken in St. John's Medical College and Hospital from July 2016 to September 2018. 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.

Cases were selected on the basis of a fixed inclusion and exclusion criteria which were devised in the department of orthopaedics, Tertiary care Hospital Surat.

The inclusion criteria involved the following parameters

1. Patients with fractures of the lower one third of shaft of tibia and fibula.
2. Fresh cases of lower one third leg fractures
3. Patients who attained skeletal maturity when assessed radiographically
4. Closed and Gustilo type I and type II open lower one third diaphyseal fractures of the leg.

The exclusion criteria involved the following parameters

1. Patients with upper one third and middle one third fractures of the both bones of the leg
2. Patients who did not attain skeletal maturity when assessed radiologically
3. Segmental fractures of the tibia
4. Fractures with intraarticular extension where interlocking nailing of the tibia was not feasible.
5. Gustilo type III open fractures.

All patients with fractures of the lower third of the tibia and fibula were included in the study. In all cases tibial fracture was fixed with interlocking intramedullary nail. The decision to fix the fibular fracture was by randomization of cases.

All patients underwent a primary survey and haemodynamic stabilization in the emergency department. The presence of other fractures, neurovascular status of the limb and systemic evaluation was done subsequently on secondary survey.

Appropriate anteroposterior and lateral radiographs were taken and the limb immobilized on a Thomas splint. The fracture patterns were classified according to the Orthopaedic Trauma Association classification. Open fractures were classified according to the criteria of Gustilo and Anderson.

Fracture fixation: tibia was fixed using intramedullary interlocking nail with 2 proximal and 2 distal (3 preferably

whenever possible) screws and fibula was fixed using either rush nail or anatomical plate.

Post-operative regime

Post operatively all the patients were mobilized non-weight-bearing with crutches or walker from day one of surgery. Mobilization of the knee and ankle was also started in the immediate postoperative period. Sutures were removed on tenth day of surgery.

X-ray of the involved leg was taken post operatively 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.

At the time of admission fractures were classified according to the Orthopaedic Trauma Association classification. Nature of the injury was also noted. In the post-operative 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 [3, 17, 21].

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 [17]. The final results were evaluated using the "Johner & Wruhs' Criteria" as excellent, good, fair and poor [32].

Statistical methods

The two groups, i.e. patients with fibula being fixed and those in whom fibula was not fixed, were analysed for statistically significant differences for different variables. Chi-square and Fisher exact test have been used to test the significant percentage of side distribution, nature of the injury, valgus angulation, and range of motion at the ankle, complications and the final results in patients with and without fibula fixation. Student 't' test has been used to test the significance of valgus score, ankle evaluation scoring system and the time of union in months between the patients with and without fibula fixation.

Statistical software: The Statistical software namely SPSS 11.0 and Systat 8.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables.

Study design: A prospective clinical study consisting of 18 patients who presented to Department of Orthopaedics, Tertiary care Hospital Surat Hospital with fractures of the lower third of tibia and fibula was undertaken to investigate the effect of fibula fixation based on various criteria.

Results

18 patients who had fractures of lower third of tibia and fibula who were treated in Department of Orthopaedics, Tertiary care Hospital Surat were followed up for the study. The longest duration of follow up was two years six months and shortest duration was six months. The mean duration of follow up was fourteen months.

Age incidence: Ranged from 18 to 70 years with average age for males [who were 16 in number] being 36.16 years and

average age for females [who were 2 in number] being years. The combined average age was 37.08 years.

Side of the fracture: The right side was more commonly involved [10 in number] than the left side [8 in number]. When comparing cases in which fibula was fixed to those without fixation, the side of fracture was equally distributed.

Nature of the injury: Most cases were due to road traffic accidents (86.1%). Other mechanisms which included were fall from height, assault which accounted for 13.9% of cases.

Pattern of the fracture: 61.1% were simple transverse type of fracture and 30.6% were simple oblique type. Wedge fragmented type accounted for 5.6%. Complex spiral type was present in 2.8% of patients.

Type of fracture [Open or closed]: In the study 80.6% of cases were closed fractures and 19.4% were open fractures of the tibia. Among the patients with fibula fixed 7 (81.3%) out of 8 were closed fractures. In the second group with no fibula fixation 8 (80.6%) were closed fractures. In the group with fibula fixation, 1 patient had type I and one had type II open fracture. In the group without fibular fixation 1 were type I and 1 patient had type II open fracture.

Assessment of radiological valgus/varus angulation: All the cases went for valgus angulation irrespective of whether fibula was fixed or not. The average valgus deformity of the tibia in patients in whom fibula was fixed was 6.69° and those in whom fibula was not fixed was 9.05°. To assess the effect of angulation, the patients were divided into 4 groups [32]:

1. **Excellent:** 0 -1° valgus/varus
2. **Good:** 2-5° valgus/varus
3. **Fair:** 6-10° valgus/varus
4. **Poor:** >10° valgus/varus

37.5% of patients with fibular fixation had good results, 50% of patients had fair and 12.5% had poor results. Among the patients in whom fibula was not fixed 10% had good results, 65% had fair and 25% had poor results.

Association of range of movements at the ankle [expressed as a percentage] with fixation of fibula: The mean range of movements in patients with fibula fixation was 66.98% and that in whom fibula is not fixed was 68.20%.

To assess the range of movements at the ankle, the patients were divided in to 4 groups [32]:

1. Excellent: 100% motion of ankle
2. Good: >75% motion of ankle
3. Fair: 50-75% motion of ankle
4. Poor: <50% motion of ankle

In patients with fibula fixed, 1 had good results, 6 had fair and 1 had poor results. In patients without fibula fixation 2 had good results and 8 had fair results.

Ankle evaluation rating system [17]: 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 64.25 points and for those

where no fixation was done for the fibula was 69.76 points.

Time of union: Mean time of union in patients with fibula was fixed were 5.47 months and those in which fibula was not fixed was 5.28 months.

Complications: Three out of the 8 patients in whom fibula was fixed developed superficial wound infections at the fibular wound site.

According to Johner and Wruh's criteria [32] patients were divided into four groups-those with excellent, good, fair and poor results. Among the cases with fibula fixed, 1 (18.8%) had good results, 6 (75%) had fair and 1 (6.2%) poor result. Among the 10 patients in whom fibula fixation was not done, 1(10%) had good results and 9 (90%) had fair results.

Discussion

The role of fibula fixation in distal third fractures of the shaft of tibia and fibula has not been clearly defined [18, 29, 31]. This study was conducted in 18 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 18 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 [15]. 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 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 valgus/varus angulation [2, 3, 33].
4. Comminution at the fracture site.

The average valgus angulation was significantly less [P value = 0.009] when fibula was fixed when compared to those where fibula was not fixed. Additionally, patients in whom fibula was fixed are 5.40 times more likely to have good valgus score [with p=0.104]. 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 [33]. 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 [p>0.05]. Merchant and Deitz [17] [1989] 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. 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 64.25 points and 69.76 points for patients without fibular fixation. i.e. the ankle evaluation score was statistically

similar in patients with and without fixation of fibula with p value = 0.204. 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 two years six months with a mean duration of 14 months].

Patients treated with fixation of fibula had comparatively higher complications than those without fibula fixation [$p=0.072$]. Three out of 8 patients treated with fixation of fibula developed superficial wound infections over the fibular wound site. All the three 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 [$p=0.374$].

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. The duration of follow up is less when compared to other studies, the average duration of follow up in our series being fourteen months.

Suggestions

1. The number of cases in the two groups should be more so as to detect the real differences that might exist between those with and without fibular fixation.
2. The duration of follow-up has to be longer to assess the complication rates like osteoarthritis at the ankle and functional disability.

Conclusions

Based on the results of the study, the following conclusions were reached:

1. The tibia malalignment [valgus angulation] was significantly less in patients in whom fibula was fixed in lower third tibia and fibula fractures compared to those in whom fibula was not fixed.
2. The functional score after 6 months follow up between patients with and without fibula fixation were statistically similar.
3. There is no significant difference in the time of union of the tibial fracture between the two groups of patients.
4. There was no significant difference in the rate of complications between the two groups.

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