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Managements of Distal Third Both Bone Leg Fractures By Tibia Interlocking – is Fibular Fixation Mandatory?

Dr Susanta Khuntia[1],Dr Ak Sahu[2],Dr Pc Mall[3],Dr Ak Mishra[4],
Dr Sk Panda[5],Dr Sk Sahu[6], Dr S Mohapatra[7],Dr Ak Dash[8],Dr M.Biswas[9]

Abstract: *Combined fractures of the distal third of tibia diaphysis and fibula diaphysis are a common orthopedic injury. Confusion still exists about the necessity of fibular fixation in all distal third tibial fracture. This study aims at evaluating the role of fibular fixation in the treatment of distal third tibial fractures.40 patients with concomitant fractures of tibia and ipsilateral fibula at distal third level were included in this study during a 48 month period. Patients were randomized in two groups: patients with fibular fixation (group I) and without fibular fixation (group II). The patients were followed up for at least 1 year follow up postoperatively. Johner And Wruh's Criteria was used for evaluation of functional outcome. Excellent and good results were seen in majority of the patients (85%) in group I as compared to group II (65%). Infection was seen in one patient in group I and two in group II with Gustillo-Anderson II injuries. Even though our study was limited to only 40 patients, still it proved that functional reduction of tibia could be achieved easily after fixing the fibula even without the use of intra-operative fluroscopy. With fibular fixation length of the limb was achieved and biomechanically we were able to restore the minimal amount of weight that transmits through an intact fibula. Due to more stability in fixation use of supplimentary splints were not needed and allowed early post operative mobilization and early weight bearing.*

I. Introduction

With rapid increase in high velocity trauma due to RTA, the incidence fracture of tibia is on the rise justifying to be termed as "fracture of modern age". This injury commonly occurs in males around 35–40 years of age and is usually the result of motor vehicle accidents, falls from height, sports injury or trivial domestic falls. Distal tibial fractures occur in about 38% of all tibial fractures and in about 78% of these fractures there is a concomitant distal fibula fracture [1].

The major goal in the treatment of distal tibial fractures is achieving correct alignment, length and rotation for a stable union and functionally useful limb. Yet the spectrum of injuries to tibia is so great that no single method of treatment is applicable to all fractures. External fixation, plating and intramedullary nailing (IMN) are the surgical options for tibial fracture [2]. Infection, Delayed union, non union and malunion could be complications of tibial fractures. For a combined distal tibia and fibula fracture, there exists a debate among surgeons as to whether or not fibular fixation is required as an adjuvant to IM nailing of tibia. When nailing for a combined distal tibia and fibula fracture, the distal end of nail must anchor in the physeal scar adjacent to the subchondral bone to reduce toggling of narrower nail inside a wider metaphyseal medullary canal which will prevent the nail to deviate mediolaterally and prevent malunion [1].

Presently, there is no clear consensus on the optimum management of combined distal third tibia and fibula fractures. Our objective is to determine whether combined distal third tibia and fibula fractures are more stable when fibular plate fixation is added to the standard tibial intramedullary interlocking nail.

II. Materials

This study comprised of 40 patients who satisfied the inclusion and exclusion criteria and were operated in the time period of October 2014 to November 2016. Age ranged from 18 to 55 years with maximum no of patients in their 3rd decade (younger age group). 27 were males and 13 were females. 25 were due to RTA and 12 were due to fall from height and 3 were blunt trauma patients. 60% patients were transverse, oblique and spiral type rests were comminuted and segmental. 90% cases were closed # and 10% cases were compound # of grade I & II. Maximum patients were alcoholics.

Inclusion Criteria of this study were patients with age more than 18 years, both sex, Fresh fractures with fracture of both Tibia and Fibula of the leg involving region between mid 1/3rd and distal 1/3rd junction to 3-4 cm proximal to the ankle joint, with no medical comorbidities, Closed and Gustilo & Anderson type I & II open fractures. Exclusion criteria of this study were Patients less than 18 years of age , Patients with medical comorbidities, Patients with intra-articular fractures of the distal third of the tibia and fibula, Patients not willing for surgery, Gastilo & Anderson type III open fractures, Associated neuro-vascular injuries and Pathological fractures.

Ethic's committee/institutional research board approval was obtained prior to the initiation of the study. All patients enrolled in the study signed an informed consent form and were willing to return as per the required postoperative follow-up visits.

20 Patients underwent intramedullary interlocking nailing for tibia with fixation of fibula with plates and screws (group I) and the other 20 patients underwent intramedullary interlocking nailing for tibia without fixation of fibula (group II). The decision to fix the fibular fracture was done by randomisation of the cases. The study type was prospective Cohort study with a minimum 1 year follow up post-surgery.

III. Methods

Reamed intramedullary interlocking nailing was inserted in all the patients. All procedures were performed under spinal or epidural anesthesia with a mid-thigh pneumatic torniquete. For the fibular fixation group, fibular fracture was reduced by direct reduction method and then fixed first with a 3.5 DCP through a lateral approach. The wound was closed over a suction drain. Then we performed nailing of the tibia. We preferred to hang the injured leg by the side of the OT table with a bump under the popliteal fossa to perform interlocking nailing. With the assistant providing a moderate amount of traction and ensuring rotational alignment, through a slight medial entry point serial rreaming was done and a proper size nail was inserted. The proximal holes were either dynamically locked or locked both statically and dynamically as per the fracture pattern. The distal locking bolt configuration consisted of two bolts from medial to lateral. Open fractures in both groups were operated within 24hrs of injury with thorough debridement and irrigation lavage.

Knee and ankle mobilization exercises, static quadriceps exercises and non weight bearing crutch walking were started as early as possible when pain subsided. Post operatively patients were assessed clinically, functionally and radiologically after 1, 2, 6 and 12 months. Partial weight bearing with the help of a walker was allowed after 1 monthand full weight bearing was allowed after 2 months post-op. Each patient was followed up for one year. At the end of 1year patients were assessed clinically, radiologically and functional outcome by using Johner and Wruh's criteria. Results including malunion, nonunion and infections were analyzed. We used the method of Freedman and Johnson to determine the loss of reduction[13]..Malrotation was assessed clinically. We compared the proportion of cases losing reduction that were in group I to those in group II. Nonunion was defined as absence of radiological progression to union until 6 months

IV. Results

90% of patients were allowed non weight bearing walking with crutch from 3rd post-op day onwards. Patients with fibula fixation group started partial weight bearing from 3rd weeks post-op period as compared to 6th weeks post-op period in non-fixation group, then in both the groups were allowed for gradual increase load bearing walking till full weight bearing walking as decided by radiological sound callus formation and clinically pain free symptoms.

Majority of patients of both groups union occurred at 16 to 17 weeks of post operative with Average time of union came out to be 16.6 weeks in non-fixing group and 17.85 weeks in fixing group. Most patients about 60% of non-fixing group showed some variety of deformity of valgus/varus and antiversion/recurvation in post union x-ray and some were in unacceptable range. 20% patients of fixation group showed deformity but in acceptable range (table no.1).We observed unacceptable shortening in 3 patients of non fibula fixation group and acceptable shortening in 5 patients of fibula fixation group. There were 2 patients having non union one in each group .Four patients were infected with two from each group include both superficial and deep infection Knee movement was full in 90% of cases. In three patients there was restriction of 10°-15° of flexion with no extension lag. Ankle movement was full in 80% cases. In 3 out of 8 patients; ankle movement was restricted by 25% in dorsiflexion

Johner And Wruh's Criteria was used for evaluation of functional outcome. Excellent and good results were seen in majority of the patients (85%) in fixation group as compared to non fixation group about 65% and very less number in fair and poor result in fixation group as compared to non-fixation group (table no.3).

Table No.1

FIXATION	**DEFORMITY**										
	10° recurvation	**10° valgus**	**10° varus**	**15° antiversion**	**15° valgus**	**5° antiversion**	**5° recurvation**	**5° Valgus**	**5° Varus**	**Nil**	**TOTAL**
DONE	0	0	0	0	0	1	0	1	1	17	**20**
NOT DONE	1	2	2	1	1	2	1	3	0	7	**20**

Table no.2 Functional Result (Johner And Wruh's Criteria)

Functional Result		Fibula fixation done Number	Fibula fixation not done Number
Excellent	No non union, no varus/valgus, 0-5˚anteversion/recurvation, 0-5mm shortening, normal knee, ankle mobility, no pain, possible strenuous activity	10	6
Good	No non union, 2˚-5˚ varus / valgus, 6˚-10˚ anteversion / recurvation , 6-10mm shortening, >80 %mobility,occasional pain, limited activity	7	7
Fair	No non union,6˚-10˚ varus / valgus , 11˚-20˚ anteversion/ recurvation, 11-20 mm shortening, >75% mobility,moderate pain, severly limited activity	2	5
Poor	Non union, > 10˚ varus/ valgus, > 20˚ anteversion / recurvation, >20mm shortening, <75 % mobility, sever pain, impossible activity	1	2

V. Discussion

Distal fractures are prone to malalignment because the metaphysis is much wider than the diameter of the nail and care must be taken to avoid malunion as this may lead to a worse functional outcome [1]. The keys to avoiding malalignment distally are ensuring the guidewire is placed centrally on both the AP and lateral images (the "center-center position") and keeping the fracture well aligned during reaming and nail insertion. The techniques including percutaneous clamps, temporary external fixator placement, and blocking screws, can be very useful for this fracture pattern alignment[3]. For distal tibia fractures that also have a fibula fracture, plating of the fibula fracture before nailing of the tibia can help provide alignment and length[1]. This is particularly useful for simple fibular fracture patterns and very distal tibial fracture patterns. Care should be taken to reduce the fibula as malreduction of the fibula will prevent accurate reduction of the tibia. After the fibula is plated, care should be taken to make sure the tibia is not malaligned in varus as the fibular plating will keep the tibia out to length laterally, but will typically not prevent varus collapse.

Lambert[3] demonstrated that the fibula has weight bearing function, carrying 1/6 of the load applied to the knee joint. With ankle in neutral position, load distribution to the fibula has been shown to average between 6% and 7% of the total load transmitted through both the tibia and fibula [4,5].

The fibula has also been shown to contribute to the biomechanical stability of the ankle mortise during gait. From plantarflexion to dorsiflexion of the ankle, Close [6] reported an increase in intermalleolar distance of 1.5 mm and lateral rotation of the fibular by 2.5°. This motion is in part due to the trochlear shape of the talar dome being wide anteriorly and narrows posteriorly. Scranton et al[7] demonstrated that the fibula descends approximately 2.4 mm during stance phase of gait. This deepening of the mortise during dorsiflexion of the ankle acts to create a close-pack stable position of the ankle in preparation for the toe-off phase of gait.

The interosseous membrane between the tibia and fibula has been shown to function as a conduit for stress transmission, creating a load sharing function of the fibula. In a holographic investigation of cadaveric limbs, complete sectioning of the interosseous membrane decreased fibular load transference by 30%[9]. In another study, complete transection of the interosseous membrane decreased fibular strains to near zero[9]. These findings suggest that the tibia will bear most of the weight bearing stress in the presence of interosseous membrane disruption

Prior studies have suggested fibular fixation may influence outcomes of distal tibial fractures favourably but significant complications have also been reported with this adjunctive stabilisation. High-energy fractures of the distal tibia are associated with a high incidence of soft tissue trauma compromising the soft tissue envelope. So ORIF of the fibula has also shown an increased rate of wound complications In addition, the incidence of fibular nonunions was 9% with fibular fixation (possibly from further devascularisation on open surgical approach in contrast to zero without fibular fixation[10].

There are no studies that elucidate the effect of fibular fixation on union rates of tibial fractures. However, several clinical reports have demonstrated that fracture stability of the distal tibial with an intact or stabilised fibula does not ensure successful healing. Other reports of delayed tibial fracture healing with an intact or healed fibula have suggested that an intact fibula may prevent cyclic compression of the fractured tibia necessary for physiologic bone healing[11].

VI. Conclusion

Based on the result of this study, we conclude that fibula fixation in addition to interlocking nail for distal 3rd both bone fracture leg gives easy reduction of tibia fracture and better control over the anatomical length and rotational alignment of the limb with no effect on union rate and infection. But this study had several limitations. The volume of each group was small but statically worth enough regarding the main criteria. However, a larger number of cases would have given more power to this study. Another bias could be the number of different surgeons. Finally, the mal-alignment in rotation was only assessed clinically without precise assessment by CT scan

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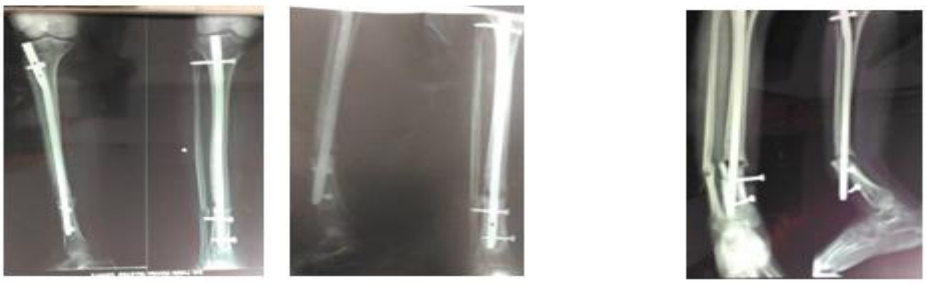
[13]. case1 Fibula fixation case

case1 Fibula fixation case

case2 Fibula non fixation case



Case3 Fibula fixation case