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Research Article

Functional outcome of distal 3rd both one leg fracture with and without fibula fixation

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Abstract

Introduction: For combined distal tibia and fibula fractures, surgeons doubt regarding the fibula fixation as an adjuvant to IM nailing of the tibia. For a functionally useful limb, it is important to achieve correct alignment, length, and rotation in distal tibial fractures.

Aim: To assess fibula fixation in distal both bone leg fractures in terms of Stability to fracture reduction, radiological union, functional outcome, and complications like malalignment.

Methodology: In 60 patients, in all cases, fixed tibia fracture with IM nail, and for fibula, 30 cases fixed with 1/3rd tubular plate and reviewed these cases periodically at 4, 8, 12 weeks and 24 weeks clinically and radiologically for the bony union. Functional and Radiological outcome (RUST SCORE) regarding union of fractures and complications, evaluated and documented. Outcome compared with JOHNER and WRUHS criteria.

Results: The moderate valgus deformity was significantly less in cases where fixed the fibula. Mean ROM was 78% inpatient without fibula fixation and 76% with fibula fixation. The mean union time in patients with fibula fixation was six months, and without fixation was 5 months. Both groups had similar clinical ankle scores, times of union, complications, and functional outcomes according to JW criteria.

Conclusion: Fibula fixation in distal third fractures of both bones leg have better outcomes by significantly reducing tibial malalignment where the tibial fractures fixed with IM nail have. There is no significant difference in the union time, complication rate and functional outcome between the two groups of patients.

Key Words: distal tibia fibula fracture, IM nailing, plating, JW Criteria

INTRODUCTION

The rapid growth of industrialization and technology has led to the extensive use of new vehicles on the road. Road traffic injuries and deaths have increased because of this growth. In India, more than 1,58,700 lives are lost yearly due to road traffic accidents (WHO global safety report 2018). According to WHO Report in 2018, road traffic injuries ranked 8th cause of death.

Tibial Diaphyseal Fractures are one of the most frequent long bone fractures encountered. The distal third region accounts for about 37% of all tibia shaft fractures. It is expected that severe complications and significant disability may result from the subcutaneous nature of the tibia shaft throughout its length 6 distal tibia fractures are more challenging to treat than mid-diaphysis tibia shaft fractures. Several advantages of intramedullary interlocking nails include fewer wound complications, early mobilization, and less incidence of angular deformities or misalignment. Fractures at the distal end of the tibia have shown higher rates of non-union, malunion, and malalignment complications due to its wider intramedullary canal. A mal-aligned tibial fracture may result in an imbalance of articular surface pressures, which may result in premature osteoarthritis as the deformity approaches the ankle or knee.

It's been shown that fibular fixation, in addition to IM tibial nailing, is not required when an ipsilateral fibular shaft fracture accompanies a mid-shaft tibial fracture. For a distal 3rd tibia and fibula fracture, there is a debate among orthopaedic surgeons about whether to fix the fibula with IM tibia nailing. There is no established role for the fibula in maintaining stability after distal tibia fracture fixation. Compared to intramedullary nailing alone, fibula plating increased rotational stability and good alignment after distal tibial fracture, thereby preventing varus and valgus malunion. Should take care of fibula reduction as malreduction of fibula will prevent accurate reduction of the tibia. Presently, there is no consensus on the optimum management of combined distal third tibia and fibula fractures. So further studies on the clinical efficacy of this technique are needed. So, it may be advantageous to fix the fibula and then nail the tibia to avoid complications and to know that such a procedure affects the healing period. So, there is a need for a prospective comparative study of this standard procedure [1,2].

MATERIALS AND METHODS

The prospective study was conducted between October 2017 and May 2019 at Victoria and Bowring & Lady Curzon hospitals of Bangalore Medical College & Research Institute, with 60 patients, 30 with fibula fixation and 30 without fibula fixation. In these cases, the bony union was evaluated both clinically and radiologically after 4, 8, 12 and 24 weeks. We evaluated and documented fracture union and complications in accordance with radiological criteria (RUST SCORE). Based on Johner and Wruhs criteria, functional outcome was compared [3,4].

INCLUSION CRITERIA

Informed consent given by patients the distal third leg fracture needs to be 8 cm proximal to the ankle joint for two distal locking bolts to be inserted. Age of patients from 20 years–50 years of either sex. Closed and Gustilo Anderson type 1 and 2. Skeletally matured patient.

EXCLUSION CRITERIA

Patients with upper-third and middle-third fractures of both legs. Gustilo Anderson type. Fractures of the tibial plafond. Tibial segment fractures pathological fracture conditions that preclude major surgical procedures due to co-morbidities uncooperative patients. The patient is not willing for surgery the patient is not willing to informed consent.

METHODOLOGY

From November 2017 to May 2019, a prospective study was conducted at Bangalore Medical College and Research Centre in the Department of Orthopaedics. In this study, sixty patients were included after obtaining informed written consent. Out of 60 patients in all cases, tibia fracture was fixed with IM nail, and for fibula, 30 cases were fixed with 1/3rd tubular plate. Clinically and radiologically, these cases were reviewed periodically at 4 weeks, 8 weeks, 12 weeks and 24 weeks. We evaluated and documented fracture union and complications based on clinical outcome and radiological criteria (RUST SCORE). Based on Johner and Wruhs criteria, functional outcomes were compared.

PRE-OPERATIVE ASSESSMENT

X-ray of the fractured leg, including the ipsilateral Knee and Ankle Joints.Two views, Anteroposterior and Lateral Views taken. Nail length is measured clinically from the tibial tuberosity to the medial malleoli of the opposite leg.

OPERATIVE PROCEDURE

THE TECHNIQUE OF INTERLOCKING NAILING OF THE TIBIA

The patient was taken in a supine position on the fracture table. The limb was painted and draped and kept freely hanging down from the side of the operating table. The C-arm is covered with a sterile drape. Across the midline, a 5cm longitudinal incision is made between the inferior pole of the patella and the tibial tuberosity. The patellar tendon was split or retracted. The entry point is 3mm medial to the tibial crest in the frontal plane and distal to the angle between the tibial plateau and anterior tibial metaphysis. A solid curved bone awl is inserted through the same entry point. A ball-tipped guide wire passed into the medullary canal to distal metaphysis while keeping the fracture in reduction. Under fluoroscopic guidance, the guide wire tip is positioned above the centre of the ankle joint. Cannulated flexible reamer inserted over the ball tip guide wire. A nail is chosen of adequate length and diameter of 1 mm to 1.5 mm smaller than the last reamer used. A Medullary Exchange tube is used to exchange guide wire. The cannulated nail is inserted over the guide wire with the knee in flexion and keep it below the surface of the bone at the entry point to avoid impingement on the patella. Proximal locking screws are inserted using instrumentation. An image of locking holes under fluoroscopy is used to create 'perfect circles' for distal locking [5,6]. A drill bit is placed through a small incision overlying the hole and at the centre of the tip of the hole. Drill advanced into the near and far cortex. Adequate size screw inserted and confirmed in fluoroscopy

TECHNIQUE OF FIBULA FIXATION

A straight incision of around 10 cm was made along the shaft of the lower third of the fibula. The plane is formed between the peroneus Tertius anteriorly and the peroneus longus and brevis posteriorly. The fracture site was exposed after reflecting the periosteum. After reduction, fibula fixed with adequate size plate (Figure 1).

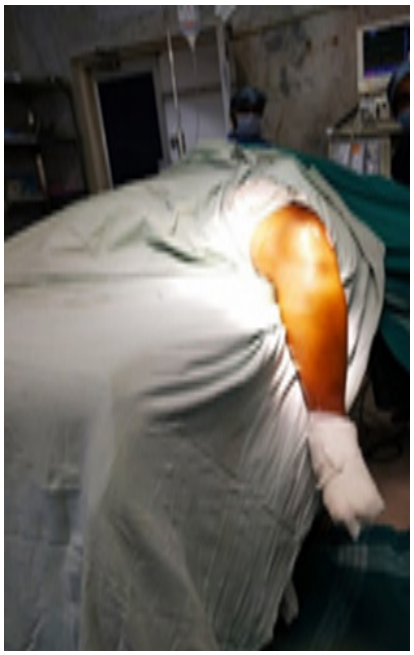

Fig 1. Position of limb

POST OPERATIVE PROTOCOL

Static Quadriceps strengthening exercise and Ankle movements started on day 1. Once Pain decreases, Knee ROM exercises are started.Suture removed on 14th Postoperative day. Non–Weight-bearing walker assisted ambulation till six weeks partial Weight-bearing starts once callus formation is seen on Xray's (6 weeks to 3 months), and Full weight starts once the radiological union of 3 cortices seen The ankle's ROM was determined after six months. The "Ankle-Evaluation Rating System" by Merchant and Deitz is used to assess ankle function. The final analysis used Johner&Wruhs Criteria [7,8].

STATISTICAL SOFTWARE

SPSS 22.0 and R environment version 3.2.2 were used to analyse the data.

RESULTS

AGE DISTRIBUTION

There was an age range of 20 to 70 years, with an average age of 41.3 years (Figure 2 and 7).

Fig 2. Incision

Fig 3. Intra op picture of fibula plating

GENDER DISTRIBUTION

81.7% were male, and 18.3% were female.

SIDE OF FRACTURE

In the study predominance side of the fracture was right, involving 58.3% of cases, and 41.7% were left.

TYPE OF FRACTURE

In the study, 76.7% of cases were closed fractures, and 23.3% were open fractures.

PATTERN OF FRACTURE

In the study, 33.3% were simple transverse fractures (A3) followed by bending wedge fractures (B2), involving 25% of cases.

RANGE OF MOVEMENTS

Patients with fibula fixation had a mean range of motion of 77.97%, and those without fibula fixation had a mean range of motion of 76.56%.

ROM assessment(%)

Poor: <50 %

Fair: 50% to 75%

Good: 75% to 99%

Excellent: 100%

ANKLE EVALUATION RATING SYSTEM (AERS)

At the end of six months, ankle function was evaluated clinically using Merchant and Dietz's criteria. In group 1, the mean AERS is 82.90 points, while in group 2, the mean AERS is 84.7 points.

RADIOLOGICAL ANGULATION VALGUS/VARUS ANALYSIS

In any case, whether the fibula is fixed or not, the valgus angulation occurs. Deformities of the tibia averaged 3.35° in patients with a fixed fibula, and 4.49° in those with an unfixed fibula.

To assess the effect of angulation

Poor: 10°

Fair: 6° to 10°

Good: 2° to 5°

Excellent: 0° to 1°

TIME OF UNION

In Patients with fixed fibulas had a mean time of union of 6.02 months, while patients without fixed fibulas had a mean time of union of 5.92 months [9,10].

COMPLICATIONS

Two patients in group 1 and six patients in group 2 (fibula fixed) got superficial infection (Figure 4-7).

X RAYS

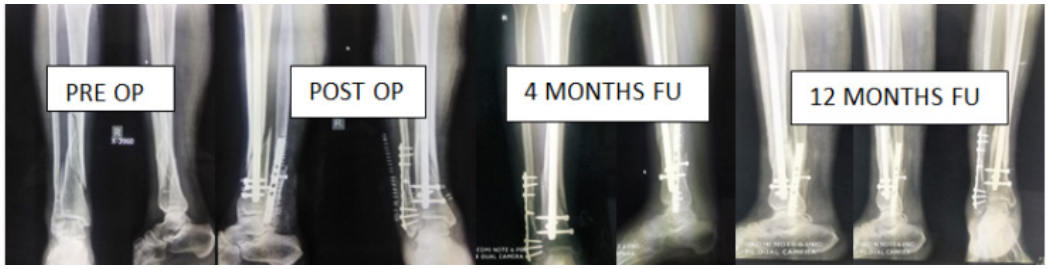

Fig 4. Radiological follow- up x-rays

Fig 5. Assessement of range of movement

Fig 6. Radiological follow up x-rays

Fig 7. Assessement of range of movement

DISCUSSION

High-energy trauma or low-energy torsional injuries can cause distal third bone leg fractures. The distal 3rd tibia fracture presents special challenges because of its limited soft tissue encasing, its location subcutaneously, its limited blood supply, and the limited options for surgical incisions. The theoretical benefits of fibula fixation are better control over the length, rotation of limb and anatomical alignment but delayed union and non-union may occur as it inhibits the cyclic loading on tibial fracture site.stated Fibular and tibial fractures should be treated as a single biomechanical and pathological entity and double surgical fixation should be considered as an aid to tibial reduction and stability. Provide fixation for the fibula first before tibial nailing to obtain reduction along the length of the bone as well as both frontal-sagittal and rotational correction of the tibia. An analysis of 60 patients was conducted to compare the results of fibula fixation with unfixed fibulas in fractures of the lower third of the shaft of the tibia and fibula. Interlocking intramedullary nails were used to treat all fractures of the tibia [11,12].

Study of 53 patients, the case group consisted of 24 patients with a mean age of 24.2 ± 7.8 (22 males and 2 females). The control group consisted of 29 patients with a mean age of 28.6 ±10.3 (23 males and 6 females) 16 study group 1(fibula stabilized) consisted of 18 male and 6 females with mean age of 41.6 year. In group 2 there were 31 male and 16 females with mean age of 43.1 year (fibula does not fix). In our study age ranged from 18 year to 70 year. with combined average age is 41.3 year. In our study there is predominance of right side of fracture comparable to study 61.3% patients were having A3 pattern and 30.6% having B2. In study of distal leg fractures,142 patients were divided in three subgroup 77 A1 fractures, 28 A2, and 37 A3. Kenneth et al16 study group 1(fibula not fixed) 14 cases were A1 and 7 were A2 while in group 2 22 cases were A1 and 12 were A2 [13,14].

In our study, A3 was a more typical pattern of fracture in AO with 33.3%, followed by B2 with 25%. Whatever the fibula fixation status, all cases underwent valgus angulation. It may be due to the wider diameter of the medullary canal of the lower fragment. Also, the short distal tibial segment or the guide wire placement may not be in the centre of the medullary canal and perpendicular to the tibial plafond. Variations from this can result in the distal segment being oriented for Valgus/ Varus angulation and fracture comminution [15,16].

A significant difference was found between patients whose fibula was fixed and those whose fibula was not fixed for valgus deformity of the tibia (P=0.051+, significant). Fixing the fibula resulted in a significant reduction in valgus angulation. A lateral column's length is determined by the fixation of the fibula. Fixing the fibula prior to nailing the tibia helps to restore alignment of the proximal and distal tibial fragments10. In study of ROM in fibula fixed group is 67.25% and in not fixed group 67.35%. In study group A 22(73.3%) patients were having good ROM and 8(26.7%) were having fair while in group B 20(66.67%) patients were having good and 10(33.33%) were fair ROM. In study of Patients had a mean range of movement of 77.73%. A total of 15 patients were evaluated. Two patients (13.3%) had excellent results, ten patients (66.6%) had good results, (20%) had fair results, and no patient had a poor outcome. In our study range of motion at the ankle was statistically similar (p>0.05) in patients with and without fixation of the fibula with mean ROM in group 1(fibula not fixed) is 77.97% and in group of fibula fixation is 76.56%.

Clinical trial of 37 patients who were followed up for 29 years, the mean ankle evaluation score for patients with a distal third of the tibia shaft was 88.4 points. Treated their series of patients non-operatively with casts.In our study, the mean ankle evaluation score for patients with fibular fixation was 84.47 and 82.90 points for patients without fibular fixation, i.e., the ankle evaluation score was statistically similar for both groups. A distal tibial fracture is studied in the context of fibular sparing. Due to the inhibiting cyclic compression theory (factor necessary for physiologic fracture repair), sparing the fibula may facilitate rapid fracture healing. In cases of tibial non-union, some studies recommend

fibulectomy or fibular osteotomy. There was a mean time of union of 5.47 months in patients with a fixed fibula and 5.28 months in patients without a fixed fibula. Found that fibula fixation did not influence the time of union. Union of all fractures was achieved within the acceptable timeframe. In study Prasad et al12 the mean time of union in patients in group with fibula fixation was 4.93 months and in group without fibula fixation it was 5 months. In our study, patients whose fibula was fixed had a mean union time of 6.02 months, while those without fibula fixation had a mean union time of 5.92 months (p=0.554). A3 fractures have a mean time to union of 5.89 months, while B3 fractures have a mean time of 6.5 months. Varsalona and Liu31 concluded, an improper reduction and fixation of the fibula may cause additional soft tissue damage and a higher incidence of late malunion. The fibular fixation method was associated with an increased risk of infection, according our study 6 cases got superficial infection in group with fibula fixation and 2 cases in group without fibula fixation. Infection was treated with regular dressing and antibiotics [17,18].

Based on Johner & Wruh's criteria, both fibula fixation and non-fixation patients had similar results. (P=0.258). Out of 60 patients forty-one patients have good functional outcome in that 18 were from group 1(not fixed) and 23 were from group 2 (Fibula fixed). In five patients's functional outcome were excellent.

CONCLUSION

When distal third fractures of both bones of the leg are treated with an IM nail, fibula fixation has significantly better outcomes by reducing tibial malalignment (varus/valgus). Anatomically, fixing the fibula before fixing the tibia helps restore the height of the lateral column and reduce the tibia. It may explain the lower valgus/varus angulation associated with fixed fibulas.

Neither group of patients significantly differs in the time it takes for their tibial fracture to heal. Complications did not differ significantly between the two groups.

Fibula fixation and non-fixation patients showed similar functional scores.

References:

1. *Jarrod AE, Oxon MD. The incidence of Alkaptonuria: a study in chemical individuality. The Lancet 1902:161-20.*
2. *Hallowell TR, Gallagher JA, Ranganath L. Alkaptonuria: a review of surgical and autopsy pathology. Histopathology 2008;53:503-12.*
3. *Taylor AM, Boyde A, Wilson PJ, et al. The role of calcified cartilage and subchondral bone in the initiation and progression of Ochronotic Arthropathy in Alkaptonuria. Arthritis Rheum 2011;63:3887-96.*
4. *Gil JA, Wawrzynski J, Waryasz GR. Orthopedic manifestations of ochronosis: pathophysiology, presentation, diagnosis, and management. Am J Med 2016;129:536.e1-6.*
5. *Mannoni A, Selvi E, Lorenzini S, et al. Alkaptonuria, ochronosis, and ochronotic arthropathy. Semin Arthritis Rheum 2004;33:239-48.*
6. *Rasul Jr AT, Fischer DA. Primary repair of quadriceps tendon ruptures. Results of treatment. Clin Orthop Relat Res Apr 1993(289):205-7.*
7. *McNeilan RJ, Flanigan DC. Quadriceps Tendon Ruptures. In Hamstring Quadriceps Inj Athl. 2014, 103-19.*
8. *La Du BN, Zannoni VG, Laster L et al. The nature of the defect in tyrosine metabolism in alkaptonuria. J Biol Chem 1958; 230: 251-60.*
9. *O'Brien WM, La Du BN, Bunim JJ. Biochemical, pathologic and clinical aspects of alkaptonuria, ochronosis and ochronotic arthropathy: review of world literature (1584-1962). Am J Med 1963;34:813-38.*
10. *Phornphutkul C, Introne WJ, Perry MB, et al. Natural history of alkaptonuria. N Engl J Med 2002; 347: 2111-21.*
11. *Zannoni VG, Lomtevas N, Goldfinger S. Oxidation of homogentisic acid to ochronotic pigment in connective tissue. Biochim Biophys Acta 1969;177: 94-105*
12. *Lorenzini S, Mannoni A, Selvi E et al. Alkaptonuria. N Engl J Med. 2003; 348(14):1408.*
13. *Aydogdu S, Cullu E, Ozsoy MG, et al. Cementless total knee arthroplasty in ochronotic arthropathy: a case report with four-year follow-up. J Arthroplasty 2000;15:539-43.*
14. *Carrier DA, Harris CM. Bilateral hip and bilateral knee arthroplasties in a patient with ochronotic arthropathy. Orthop Rev 1990;19:1005-9.*
15. *Dom K, Pittevils T. Ochronotic arthropathy, the black hip: case report and review of the literature. Acta Orthop Belg 1997;63:122-5.*
16. *Emel E, Karagoz F, Aydin IH, et al. Alkaptonuria with lumbar disc herniation: a report of two cases. Spine 2000;25:2141-4.*
17. *Suzuki Y, Oda K, Yoshikawa Y et al. A novel therapeutic trial of homogentisic aciduria in a murine model of alkaptonuria. J Hum Genet 1999;44:74-9.*
18. *La Du Jr BN. Are we ready to try to cure alkaptonuria? Am J Hum Genet Apr 1998;62(4):765-7.*