



ORIGINAL RESEARCH PAPER

Orthopaedics

TREATMENT OF TIBIAL NON UNION BY PARTIAL FIBULECTOMY

KEY WORDS: Tibial non union, Fibular osteotomy, Callus

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ABSTRACT

BACKGROUND Tibial Shaft fractures show improved rate of union but still small number of patients go for non union/delayed union. Many treatment strategies are available for this
AIM This study aims to evaluate partial fibulectomy as an effective treatment option in the treatment of certain types of tibial nonunions.
PATIENTS AND METHODS This prospective study included 8 patients with established tibial nonunion. The patients were evaluated clinically and radiologically for union until complete union occurred
RESULTS All the fractures healed with an average of 15 weeks (range 10–19 weeks) after partial fibulectomy with acceptable alignment in coronal and sagittal planes. No complications were seen.
CONCLUSION This study proved to be satisfactory and the results obtained were significantly useful for tibial nonunion.

INTRODUCTION:

The US Food and Drug Administration defines nonunion as a fracture that is at least 9 months old and it should not have shown any signs of healing for 3 consecutive months [1,2]. Many Orthopaedicians find the management of pseudoarthrosis of tibia or delayed union of fracture problematic. For fracture healing, biomechanical stability and biological vitality are important. The treatment mainly consists of bone grafting, combined with freshening of the fracture ends and fixing with Nail/ plate. An intact fibula might keep the tibial ends apart. Functional impairment following fracture nonunion is associated with pain, functional and psychosocial disability [3].

Biomechanical principles of partial fibulectomy:

About 6-15% of the load in the lower extremity is carried by Fibula. Therefore, healed or intact fibula resists compression at the tibial nonunion site [4]. Thomas et al. [5] used cadaver lower limbs to study the stress on the tibia and fibula. It was demonstrated that while loading on an intact tibia there was continuous tension on the anterior surface. The tension reduced after partial fibulectomy. When a transverse fracture was made to tibia with an intact fibula, there was a decreased compressive force causing to the formation of gap anteriorly. Partial fibulectomy showed to increase the compressive force anteromedially on tibia and helped to close the gap [5]. Fracture to the shaft of fibula along with ipsilateral tibial fracture usually heals within 6 weeks time; hence, for delayed union/ non union tibia the fibula is mostly intact. When a tibial fracture is supposed to be compressed with an intact fibula, a fraction of applied force will be spent to deform the intact fibula, which thereby can decrease the compressive force to the tibial fracture fragments. Similarly, the healed fibula might prevent compressive forces acting on tibial fracture site and therefore healing of tibia is affected [6].

MATERIALS AND METHODS

This prospective study was conducted from September 2019 to March 2021 in the Department of Orthopaedics at Meenakshi Medical College and Research Institute, Kancheepuram; 8 patients with established tibial nonunion were included. Duration of the nonunion ranged from 9 to 20 months (mean 12 months). There were two (25%) female patients and 6 (75%) male patients. Their ages ranged from 38 to 64 years (mean 56 years). All of the patients were cases of non union following intra-medullary nailing or previously conservatively treated using functional bracing. All patients had closed leg fractures. According to the type of nonunion, 6 (75%) patients had hypertrophic nonunions and two (25%) patients had oligotrophic or atrophic nonunions.

Inclusion And Exclusion Criteria

Nonunion of tibia without bone loss was included in this study. Infected tibial non- union was included in the study. This treatment is ideal for patients with hypertrophic non-union which is aligned in both the coronal and sagittal planes and fixed by interlocking tibial nail by a closed technique or conservatively treated with functional bracing and that was or was not dynamized later with intact fibula or fibular fracture that had united already.

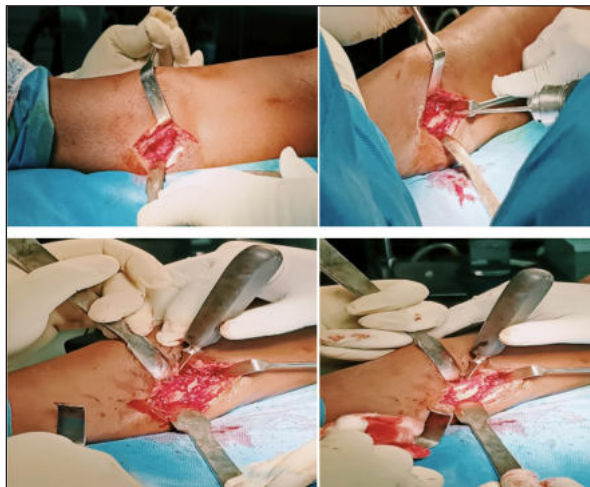
The preoperative evaluation

The patients were all evaluated preoperatively. The process begins with a thorough history taking, which includes the injury date and the mechanism of injury which resulted in the fracture. Pre-existing medical problems (e.g. diabetes, malnutrition, and metabolic bone disease), any other disabilities, any injuries associated that might have an impact in the management was ascertained. Detailed history of all previous surgeries done for fracture healing and non-union of fracture were obtained [7]. Complete physical examination was done. Overlying skin and soft tissue over fracture site was examined. Any discharge or sinus were noted. Any deformity was noted, described and documented. Non union site was examined for motion and pain using stress testing. On examining no apparent mobility was found in hypertrophic non union site of tibia indicating some callus formation and also probably had good vascularity. Similarly Nonunions showing more motion had poor callus, and also probably had less vascularity in non union site. Minimal tenderness on tibial non union site was found on palpation. When fibula was intact or healed, assessment of motion at non union of tibia was not found on examination. Regular Neurovascular examination was performed. Active and passive motion at the joints distal and proximal to the non-union was assessed and documented [7]. Radiographic examination started with anteroposterior and lateral radiograph of the involved bone (which also includes the proximal and the distal joints) The non-union site was evaluated on the basis of the anatomic location, healing potential, the quality of bone, characteristics of the surface, status of pre implanted metal, any deformities. Complete blood count, C-reactive protein, and erythrocyte sedimentation rate were done in all the patients.

The procedure

Under anesthesia partial fibulectomy performed in operating room with complete sterile conditions, without a tourniquet. Skin incision made just behind and lateral to the fibular shaft in the middle 1/3rd leg. Surgical dissection is taken deep by developing a plane between peronei and soleus. The

periosteum of fibula is incised to the bone and performed longitudinally in line with the plane of cleavage. The muscles which take origin from fibula have fibers which run down from proximal to distal to the foot and also the ankle. Hence, they were stripped proximally from distal. The interosseous membrane was stripped distally from proximal. Fibula was exposed completely and then a segment of about 2.5 cm was removed from fibula. If fibula is excised less than 2.5 cms, healing of fibula might occur even before consolidation of tibia. If fibula is excised more than 2.5 cms it can result in gross instability in the tibial fracture site. The peroneal artery and veins lie just behind the osteotomized site which is vulnerable to injury and hence care to be taken. Haemostasis achieved and wound closed in layers. If patient was not nailed for tibia, PTB cast was applied in the operation theatre with c-arm guidance with acceptable alignment. From Post op day 1 patient was allowed to weight bear with walker as tolerated.



a) Dissection between peronei and soleus , b) rilling done at 2.5 cm gap, C,d) Osteotomy done and 2.5 cms of fibula excised

RESULTS

This study was evaluated using clinically and radiologically. All the patients were followed for an average of 6 months (range 4–9 months). All the fractures healed with an average of 15 weeks (range 10–19 weeks) after partial fibulectomy. The fracture united with acceptable alignment in coronal and also sagittal planes. There was no significant difference in the union time with accordance to the fracture site within the same group of patients. Radiographically, in the fracture healing process there was gradual progression in callus formation until complete union occurred with crossing trabeculae in at least three cortices; the axial alignment in all planes were excellent (Fig. 4). Even in patients with oligotrophic or atrophic nonunions, gradual axial compression at the fracture site after fibulectomy by full weight bearing can result in gradual formation of callus at the nonunion sites [8]. Biological behaviour at the non union site is altered by mechanical stimulation in the form of axial loading of the nonunion site. Clinically patients were evaluated with reference to pain, walking, mobility at fracture site.



The progression of union in Hypertrophic non union following fibular osteotomy

DISCUSSION

The damage to vascularity at the fracture site and the stability at fracture site are two main factors causing non union. Poor vascularization at fracture site may be because of high-energy injuries with extensive damage to soft tissues, open fractures, highly comminuted fractures, loss of bone, stripping of periosteum during open procedure, nailing with open procedure, multiple failed procedures. Instability at the fracture can be caused by improper and poor fixation [11]. A nonfunctional, deformed limb with pain, infected, and stiffness in the adjacent joints is unsatisfactory for most patients, even if there is solid fracture healing of the nonunion. Therefore emphasis should be to bring the extremity as well as the patient to full function possible. Partial fibulectomy has been used for more than five decades to promote healing in non-union of tibia because it allows better axial loading of the tibia [6]. In the 60s, fibulectomy was a very well-established procedure in the treatment of tibial fractures and also its nonunion. In 1981, Delee et al. [9] reported 37 united tibial nonunions out of 48 after fibulectomy and weight bearing, with an average fracture healing time of 25 weeks. Moed and Watson [10] and Seldge et al. [11] used partial fibulectomy with exchange and reamed intramedullary nailing in the management of tibial non union. Teitz et al. evaluated the load on a fresh frozen adult human lower limb after making an oblique fracture in tibia while having both fibula and interosseous membrane intact. The distal tibial fragment went for varus angulation after increased load on interosseous

membrane by weight bearing was given. It brings strain in both tibia and fibula leading to nonunion or malunion. A healed fibula distracts an increased percentage of the load also it resists compression at nonunion site in tibia. Many nonunions might still have enough biological potential if a good mechanical environment is being created [12]. When nonunions are longstanding, appearing atrophic with poor vascularization, immunohistochemical localization of bone morphogenic proteins which signal components can be noted, even in areas of dense fibrous tissue, as shown by Kloen et al. [13]. When signalling of cell is preserved, the repair process of bone restarts with well-aligned mechanical loading. Therefore, a good mechanical condition may restore a disabled biological system that might promote fracture healing.

CONCLUSION

The following are the advantages of partial fibulectomy: (1) Easier to perform and can be performed by in experienced surgeons too. (2) The risk of vascular damage and infection to the fracture site itself is avoided as the fracture need not be opened. (3) Early mobilization of the patient after the operation, from Post op day 1 in our patients. (4) The operation can be performed when there is skin loss or bad skin over the fracture site (5) Can perform bone grafting with or without plating if union does not occur. (6) It can correct any malposition. Hence, Partial fibulectomy can be used for the treatment of nonunion of tibia as an easy, rapid, and inexpensive method for treating most types of non-union of tibia.

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