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# Outcome of Plate Augmentation in Management of Tibial Nonunion After Intramedullary Nailing

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**Abstract:** *Background:* Despite the multitude of studies on non union no clear criterion has been established for declaring a fracture as non united. A diagnosis of non union is unjustified, however, until clinical or radiographic evidence shows that healing has ceased and that union is highly improbable. A fracture of the shaft of a long bone should not be considered a non union until at least 6 months after the injury. The incidence of non union in the long bone varies with each bone and with methods of treating acute fractures. More recently, the tibia probably is the most frequent site of non union. Nonunion following intramedullary fixation of tibial fractures is a challenge. Although reamed exchange nailing results are encouraging with union rates, exchange nailing could be extremely challenging due to situations when nail removal is difficult. Augmentation plates gained popularity in management of femoral nonunion with few reports in tibial nonunion. The aim of the current study is to present our results in augmentation plate in management of tibial nonunion with intramedullary nail. *Patient and methods:* From 2017 till 2021, 20 cases of nonunited tibial fractures fixed by IM nails was included. Augmentation plate without removing the nail in addition of autogenous iliac graft. *Results:* Union was obtained in all the cases (20 cases) in an average time of about 6.22 months (range 3-12 months). Complications are few included 3 cases of superficial infection and parasthesia at iliac graft site. *Conclusion:* Plate augmentation without removal of IM nail is a good option in management of aseptic nonunion tibia with excellent results and few complications.

**Keywords:** Nonunion, Nail, Tibia, Plate, Augmentation

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## 1. Introduction

The process of fracture healing requires a precise balance of biology and stabilization during the healing process. There are four pillars for adequate bone healing: mechanics, osteogenic cells, scaffolds, and growth factors. In some circumstances, this process does not go as expected, and healing does not occur without additional intervention. Definitions vary among different studies, but overall, a diagnosis can be made when there is no evidence of progression of the healing process for 3 months or no healing after 9 months of the injury. [1-4]

Intramedullary nailing is the most frequently used fixation technique in lower limb long bone fractures. However a nonunion rates of about 8% and 4.6% after femoral and tibial interlocking nails respectively was recorded. Such incidence increase dramatically in open fracture tibia to about 16% in type I Gustillo open fractures and 80% in type III. [5, 6] The

aetiology of nonunion is usually multifactorial with either biological or mechanical or more commonly combined causes.

Although reamed exchange nailing results are encouraging with union rates reaching upto 90% union. [7] exchange nailing could be extremely challenging due to situations when nail removal is difficult as in cases of broken locking screws, buried nails, or unknown nail type, or in cases when large diameter nail was used in the index surgery making more reaming hazardous to endosteal blood supply of the bone.

Using plate as augment fixation over insitu intramedullary nails have been used with encouraging results in non union femoral fractures. [8] However limited reports regarding its use in nonunion of tibia exist. The aim of the current study was to report our results in plate augmentation in nonunited tibial fracture with retained IM nail.

## 2. Patient and Methods

Between Jan. 2017 and October 2021, Twenty patients with nonunion tibial fracture after fixation by IM nails were included in the current study. Exclusion criteria included patients with history of infection either active or dormant, patients less than 18 years old. Non union was defined as absence of clinical (tenderness at fracture site) and radiological signs of union after 6 months post Intra-medullary nailing with no radiological improvement in the last 3 months. Radiological nonunion was defined as presence of radiolucency at fracture site in at least 2 cortices in 2 prependicular views. Infection was diagnosed by history of early or late wound discharge or sinus, intraoperative pus, or positive culture or histopathology finding of deep samples taken intraoperatively during debridement. The study protocol was approved by the ethical committee and all patients signed informed consent.

### 2.1. Surgical Technique

All surgeries were done under local spinal anaesthesia, patients were positioned supine on a translucent orthopaedic table, and a pneumatic midhigh tourniquet set to 350 mmhg were used in all patients.

A longitudinal skin incision (8-10cm length) 1cm lateral to tibial chin, and centered over fracture was used. Fracture site was debrided and bone ends were refreshed. Autogenous cancellous bone graft harvested from the ipsilateral iliac crest was used to fill the gap and augmentation plate with at least 4 screws were applied. Usually 2 to 3 screws above the fracture and 2 to 3 below the fracture were applied. In 7 cases where the fracture was oblique, an additional lag screw was added. narrow dynamic compression plate was used in 12 patients while locked plate was used in 8.

### 2.2. Postoperative Follow-up

Stitches were removed after 10 days, and full weight bearing was allowed as tolerated, after 6 weeks, and every 2 weeks till union, Xrays were obtained postoperatively then every 2-3 months. At final follow-up, radiographs were reviewed to record any loosening or hardware failure. Union was defined as bridging callus in at least three cortices.

## 3. Results

The average time between index operation and surgery was 9 months (range, 6 to 12 months). There were 9 females and 11 males, with average age 41.6 years (22-60). The mode of trauma was high energy motor car accident in 17 patients, and sports injury in 3 patients. In 50 percent of the patient the fracture was in upper third of the tibial shaft, and in 45 percent it was in the middle and in 5 percent it was in the lower shaft. Table 1 summarizes patients morphologic characteristics.

**Table 1.** Demographic data of studied patients.

	Frequency	
	n	%
Age in years		
<30	3	15.0
30 –	7	35.0
40 –	4	20.0
50 –	6	30.0
Range	22 - 60	
Mean	41.6	
S.D.	12.5	
Sex		
Male	11	55.0
Female	9	45.0
Total	20	100

The average follow-up period was 13.6 months (range, 11 to 23 months). Union was achieved in 20 patients with average period of 6.22 months (range 3 to 12).

At final follow-up, recorded complications in addition to infection was wound dehiscence in 3 patients that were treated by daily dressing using antiseptic creams and secondary suture. Iliac graft site morbidity in the form of pain and parasthesia was recorded in 3 patients but resolved over 3 months. No screws loosening, hardware failure, or hardware related complications.

**Case:** A 33 years old male patient, non-smoker, with a sport injury sustaining a fracture upper third right tibia. (A) Primarily fixed by interlocking nail with no signs of non-union 6 months post-operative. (B) The fracture was augmented by a locked plate with bone graft. (C) X-ray six months post-operative.



**Figure 1.** Plain X-rays for a 33 years old patient with non-union fracture tibia fixed by interamedullary nail, pre-operative, post-operative and 6 months follow up.

## 4. Discussion

Managing tibial nonunion after intramedullary nailing is challenging with a lot of surgical options including dynamization, bone grafting, fibulectomy, exchange nailing, and more recently augmentation plate over nail [5].

a single procedure can suffice in managing aseptic tibial non-union. [15]

Plate augmentation with the nail insitu is not a new concept. In 1977, Ueng et al published their results of augmentation plating over nail in nonunited femur fractures and reported 100% union rate [9]. Many subsequent case series were published showing similar good results of plate augmentation over nonunited femur fracture with very minimal complications [10-13].

Medlock et al., in a recent systematic review including 21 studies comparing exchange nailing and plate augmentation and concluded that plate augmentation provided a more reliable union rates and fewer complications [8].

Contrary to plate augmentation in femoral nonunion, only few case series of it's use in nonunited tibial fracture could be found in literature. The current study presented the results of 20 patients with augmentation plating of tibial nonunion with retained insitu IM nail, with union rates of 100 percent in an average period of 6.2 months (range 3 to 12 months) and with very few complications. Results of our study match most of published similar studies.

Ateschrang et al., conducted a comparative study included 48 patients with aseptic nonunion tibia after IM nail (25 cases of exchange nailing and 23 patients of plate augmentation). He reported union in all patients except one in each group and concluded that augmentation plate group showed less operative time and union time [14].

## 5. Conclusion

Plate augmentation is a simple procedure that directly attack nonunion site with debridement and grafting and improve rotational stability of the construct without the hazards and complications of nail removal and with favorable outcome and very few complications.

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