

Aseptic Tibial non Union after Initial Locked Intramedullary Nail Fixation - An Algorithmic Approach for Management

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ABSTRACT

BACKGROUND: Aseptic tibial non union after initial locked intramedullary nail fixation is not common. There are many techniques that deal with this complication. Which is the best method is controversial. An algorithm is suggested to help choice of the most suitable technique for each case.

MATERIALS AND METHODS: In the period from august 2010 to august 2014, 29 cases of aseptic tibial non union after locked intramedullary nail fixation were treated according to a suggested algorithm based on the location of non union, percent of bone contact and nail diameter relative to the diameter of the medullary canal. The mean follow up period was 14 months. Sepsis was excluded before active management of any case.

RESULTS: All cases had united but with variable time differed according to the method of treatment and the underlying pathology. The complications were few and related mainly to cases treated with the augmentation plate.

CONCLUSION: Successful treatment of aseptic tibial non union after locked intramedullary nail fixation depends on proper identification of the exact etiology of the non union whether it was a stability problem or a biological problem or both conditions.

INTRODUCTION

Aseptic non union after initial locked intramedullary nail is not common in orthopaedic practice^[1]. However, if occurs there are many surgical techniques that deal with this complication as bone grafting, fibulectomy, exchange nail, dynamization, augmentation plating or combinations of these techniques. The question usually aroused in this condition, which is the best method to choose? In this study an algorithm based on the location of non union and the underlying pathology that predisposes to this complication was used.

PATIENTS AND METHODS

In the period from august 2010 to august 2014, 29 cases with aseptic tibial non union after initial fixation with locked intramedullary nail were treated according to the suggested algorithm (Figure 1). Twenty cases were males while nine cases were females. The mean age was 47.5 (Range 26 - 59). The mean follow up period was 14 months (Range 9 -16 months). Before active management of any case sepsis was excluded. This was based on clinical, radiological and laboratory studies. Cases included in this study had no complaint except for pain on weight bearing or on stressing the fracture site with no local inflammatory signs on the affected limb as local hotness, tenderness, erythema or swelling. These clinical data were confirmed radiographically and laboratory. Plain x-rays were free from signs of bone infection. Laboratory studies done were CBC, ESR and CRP and all were within normal values.

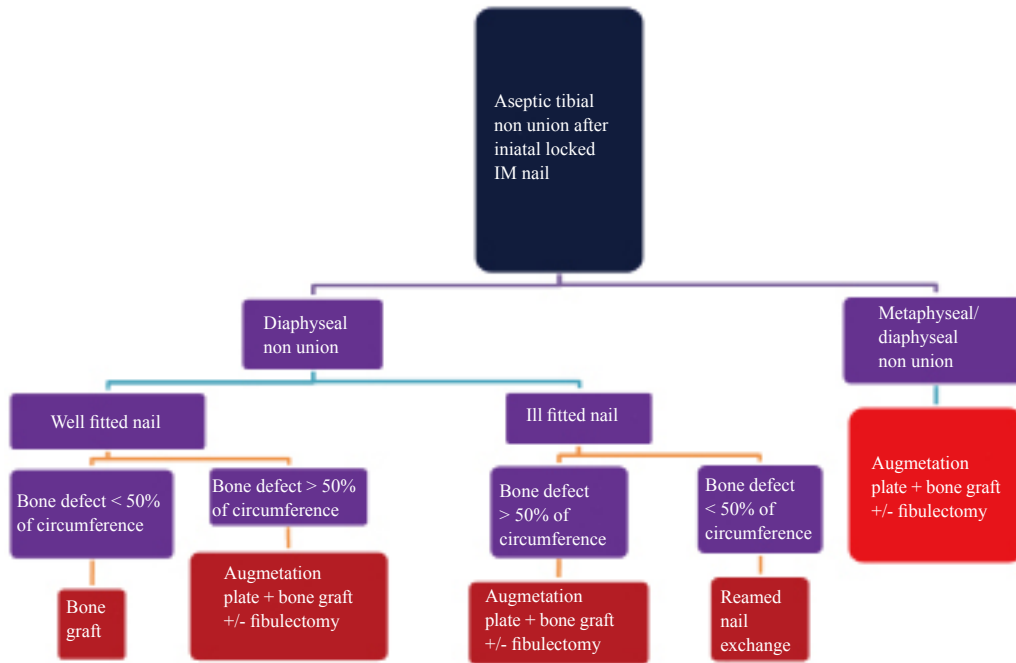


Figure 1 The algorithm used in the study.



Figure 2 Preoperative radiograph with metaphyseal diaphyseal non union with angular deformity.

The current algorithm identifies the underlying pathology contributing to aseptic non union in cases initially fixed with locked intramedullary nail and finds out the suitable surgical technique for each case. It addresses stability problems as the presence of non union in unstable location [Metaphyseal /Diaphyseal area] where the medulla has no uniform diameter, initial fracture fixation with ill fitted nail in the diaphysis or presence of marked comminution impairing fracture stability.

Cases were classified according to the location of non union into two groups (Table 1). The first group was non union at metaphyseal diaphyseal junction either proximal or distal (Nine patients). All patients of the first group had non union with angular deformity (Figure 2).

In the second group of patients (20 cases) the non union was pure diaphyseal. The second group was further subdivided according to the nail size in relation to the diameter of the medullary canal into either well fitted nail (seven cases) or ill fitted nail (13 cases). The procedures done for cases are summarized in Table 2.

For the first group of patients (Metaphyseal/Diaphyseal non union) augmentation plating was done with bone grafting after debridement of the non union site by removal of the intervening

Table 1 Patient classification.

Metaphyseal /Diaphyseal non union		Diaphyseal non union	
9 cases	20 cases	Ill fitted nails-13 cases	Well fitted nails-7 cases
Comminution more than 50%-3 cases	Comminution less than 50%- 10 cases	Comminution more than 50%-5 cases	Comminution less than 50%- 2 cases

fibrous tissue and the sclerotic bone edges. Fibulectomy was also done for all cases of this group as non union was associated with angular deformity.

For the second group of patients (Diaphyseal non union), 10 cases with ill fitted nails were treated with nail removal and exchange with the largest possible reamed nail diameter can be fitted in the medullary canal, these cases had comminution less than 50% of the circumference so no bone graft was used (Figure 3). Fibulectomy was done for one of these cases along with nail exchange for correction of rotational mal alignment.

Augmentation plating with bone graft leaving the nail in situ was done for three cases with ill fitted nail in which non union was associated with bone comminution making a defect more than 50% of circumference.

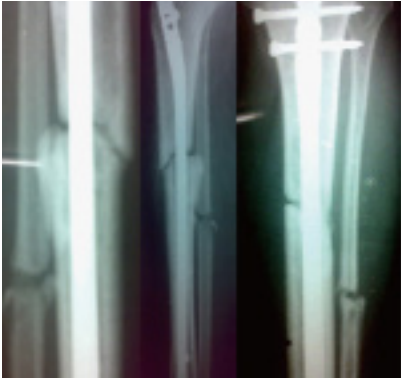
For cases that had aseptic diaphyseal non union with well fitted nail (seven cases) only bone graft was done after debridement of the non union site (five cases), these case had comminution less than 50% of the circumference. Augmentation plating and bone graft was done for two cases in which non union was associated with bone comminution making a defect more than 50% of circumference (Figure 4).

RESULTS

Healing was achieved in all cases (100%) but the time of healing was too much variable (Figure 5). This may be explained by the

Table 2 Summary of surgical procedures done for cases.

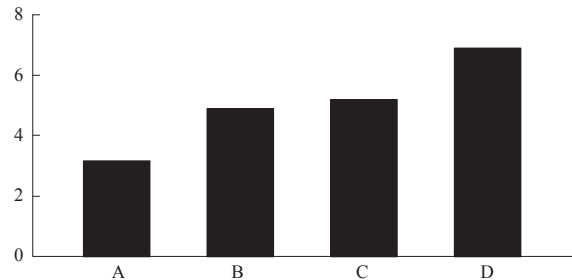
Underlying pathology	No. of cases	Procedure done
Metaphyseal - diaphyseal non union	9	Augmentation plate + bone graft + fibulectomy
Diaphyseal non union with well fitted nail with less than 50% comminution	5	Bone graft
Diaphyseal non union with well fitted nail with more than 50% comminution	2	Augmentation plate +bone graft
Diaphyseal non union with ill fitted nail with less than 50% comminution	10	Exchange nailing + fibulectomy
Diaphyseal non union with ill fitted nail with more than 50% comminution	3	Augmentation plate + bone graft

**Figure 3** Pre and postoperative x-rays after management of ill fitted nail area in diaphyseal non union with nail exchange.**Figure 4** Post operative radiograph of a case of well fitted nail with marked comminution treated with bone graft and augmentation plate.

different method of treatment used in each group of cases, the underlying pathology in each case and the location of non union.

Cases with well fitted nail without significant cortical comminuting had the fastest healing time. The mean healing time of these cases was 3.2 months. Cases treated with exchange nailing and cases with metaphyseal/diaphyseal non union treated with plate augmentation and bone graft were the second in order as regard healing time. The mean time of healing in the former was 4.9 months, while the mean healing time of the later was 5.2 months. Cases with diaphyseal non union with bone defect more than 50% of the circumference had the longest healing time of all cases. The mean time of healing in these cases was 6.9 months.

There were no recorded operative complications. However three cases had post operative early superficial infection after augmentation plating and bone graft. This complication was managed with antibiotics and repeated dressing. Two cases treated with augmentation plating had pain over the plate, this could be explained by subcutaneous position of the plate, they advised to remove the plate later.

**Figure 5** Comparison between healing times in different groups of cases. A: cases with well fitted nail and no significant comminution; B: cases with ill fitted nail with no significant comminution; C: cases with metaphyseal diaphyseal non union; D: cases with comminution more than 50% of circumference.

DISCUSSION

For any fracture to heal, it needs some sort of stability, bony contact and biological potential for healing. The locked intramedullary nails provide excellent fracture fixation in the form of axial, rotational and side to side stability^[2]. Lack of one or more of these nail functions can readily lead to delayed union and non union. Insertion of small sized nail relative to the diameter of the medullary canal as commonly used in fixation of open fractures with unreamed nails will compromise fracture stability^[3]. Another example of nail diameter mismatch with the medullary diameter is fractures of the proximal and distal tibia at the metaphyseal diaphyseal junction where the medulla widens towards the ends of bone so whatever the nail diameter used; it cannot be well fitted in the medulla to get the optimum stability for the fracture predisposing to non union with angular, translation and rotational deformities^[4].

The presence of fracture comminution impairs proper bone contact necessary for healing and impairs fracture stability. Non union with marked fracture comminution does not respond well to exchange nailing with the largest possible diameter^[5].

Exchange nailing with largest possible reamed nail is used to increase stability and activate the potential for healing as the result of reaming^[6,7]. It can do well in presence of considerable bony contact. However when bone loss is more than 50% of circumference plate augmentation is needed in these situations to add more stability^[8].

Augmentation plating is indicated whenever exchange nailing cannot afford the stability needed to achieve union as in fractures of the proximal and distal thirds at the metaphyseal diaphyseal junctions, in presence of comminution more than 50% of the circumference whatever the size of the nail already present.

Simple procedures as bone grafting is only indicated where stability is optimum and what is all needed is to activate the

potential for healing as in well fitted nails for diaphyseal fractures with minor bone defect or little distraction at the non union site.

Although isolated fibulectomy with or without bone grafting was described by many authors for management of tibial non unions^[9,10]. The concept of fibulectomy is based on increasing compression across the fracture site, a factor that will promote fracture healing. However in a statically locked nail the effect of fibulectomy will be negligible as regard increase compressive forces across the non union site. In this study fibulectomy was done for cases required correction of angular or rotational deformities or if there was distraction at the fracture site left after initial intramedullary nail fixation, otherwise the fibula is left intact as it has a role in non union stability^[11].

The limitation of this study is the small number of cases; much more cases are required to prove the reliability of the suggested algorithm for management of cases of aseptic tibial non union initially fixed with locked intramedullary nail on a large scale.

CONCLUSION

Proper identification of the underlying pathology of non union after initial locked intramedullary nail fixation is essential for proper selection of the best method for further management.

CONFLICT OF INTERESTS

The authors did not receive any outside funding or grants in support of their research for or preparation of this work. Neither they nor a member of their immediate families received payments or other benefits or a commitment or agreement to provide such benefits from a commercial entity. No commercial entity paid or directed, or agreed to pay or direct, any benefits to any research fund, foundation, division, center, clinical practice, or other charitable or nonprofit organization with which the authors, or a member of their immediate families, are affiliated or associated.

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