

# Can “Aseptic” Looking TIBIA Non-union be Result of an Unrecognized Subclinical Infection?

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## Learning Point of the Article:

Aseptic-looking non-union in long bones can be misdiagnosed and turn out to be septic non-union due to a chronic subclinical infection, making it essential to have multiple surgical options on table for such cases.

## Abstract

**Introduction:** The usual cause of a distal tibial fracture is a high-energy trauma. Although multiple options are available for their treatment such as intramedullary nailing, open plating, and external fixator, each of these options might result in a non-union. Knowing the type of non-union not only allows us to guess the cause but also directs us toward the best possible treatment. Despite this, we might still get surprises on the operating table due to pre-operative misdiagnosis.

**Case Report:** Reporting a case of a 42-year-old male with a 15-month-old left distal tibia non-union. The index injury was a grade 1 distal third tibia fibula fracture which was fixed with a plate and screws 15 months back. All the clinical and biochemical signs hinted toward the diagnosis of an aseptic non-union and the treatment was planned accordingly. However, intraoperative findings were much different due to which the surgeons had to improvise and change the intervention to an antibiotic-coated nail.

**Conclusion:** Although each variety of non-union has its set of signs and symptoms, they can be misleading. Different etiologies can coexist making it difficult to give a perfect pre-operative diagnosis and management. Non-unions, especially in the tibia, thus need meticulous understanding of the underlying disease process and extensive treatment strategies.

**Keywords:** Aseptic, non-union, septic, distal tibia, antibiotic-coated nail, subclinical infection.

## Introduction

According to the Food and Drug Administration, non-union is said to have occurred when the fracture is at least 9 months old and has shown no clinical and radiological signs of healing for three consecutive months [1]. Fracture union requires good interplay between reduction technique, surgical stabilization as well as host biology. Calori and Giannoudis described the diamond concept which tells the importance of the biological environment, factoring in osteogenic cells, osteoconductive scaffolds, and growth factors; as well as mechanical stability [1,

2]. Fracture healing would be endangered if any one of these factors is inadequate [3]. Tibia is the most commonly injured long bone [4]. The rate of tibia non-union is around 1.1% if treated nonoperatively and nearly 5% if treated operatively [1, 2, 5]. These numbers increase significantly in cases of open fractures [1]. Non-unions are especially more common in the distal third tibia due to its subcutaneous location, inadequate soft-tissue cover, and paucity of blood supply. Apart from having an inimical effect on the patient's quality of life, non-unions also have an impact on the health care cost, probably double the cost

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## Author's Photo Gallery



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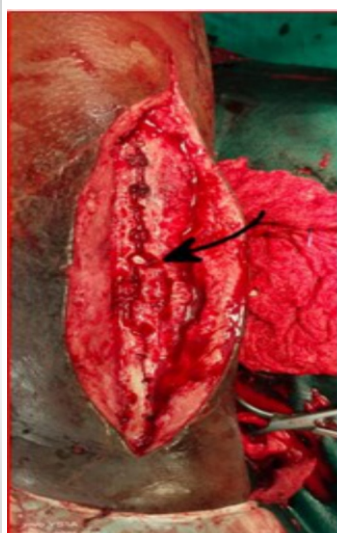
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**Figure 1:** X-ray at presentation showing frank non-union with hypertrophic callus.



**Figure 2:** Pus at one of the screw holes.



**Figure 3:** Visible gap at fracture site.

of fractures that heal normally [6, 7]. In fact, Kreder, in 2013 had commented that tibial non-union is worse than having a myocardial infarction [8]. Non-unions are broadly classified as septic (infected) and aseptic non-unions with aseptic subclassified as hypertrophic, oligotrophic, atrophic, and finally pseudoarthrosis. Diagnosing the type of non-union is vital as it gives us a clue as to what might be the possible cause of its occurrence, and guides us toward the best possible treatment.

However, non-unions with low-grade or subclinical infections are difficult to identify as they might not show any clinical or laboratory signs of infection [9]. Due to the low grade of infection, these cases may be misdiagnosed leading to a completely mismatched treatment strategy.

### Case Report

A 42-year-old male came to us with a history of a grade 1 distal third tibia fracture sustained 15 months back which was fixed with plate and screws the next day of injury. At presentation, he complained of persistent pain at the fracture site and antalgic gait. X-rays showed frank non-union with an interfragmentary screw and a 10-hole medial distal tibia locking plate in situ with 1 locking screw backed out (Fig. 1). There was adequate callus at the fracture site of tibia as well as fibula. There was no clinical, biochemical, or radiological signs of infection. A diagnosis of hypertrophic non-union was made as evidenced by improper reduction, inadequate fixation, and presence of callus. The surgical plan consisted of implant removal, fibulectomy, and replating with good reduction. However, after removing the plate and screws, we encountered pus coming out of one of the screw holes (Fig. 2). The surrounding soft tissue was healthy hinting towards an intramedullary infection (Cierny–Mader type 1 osteomyelitis). With all the callus around, there was still a visible gap and movement at the fracture site (Fig. 3). Plan was changed on the table to an antibiotic nail with fibulectomy. Intraoperative samples were taken for culture. Stainless steel tibia interlocking nail of 9\*34 was chosen and around 1–1.5 mm layer of Palacos R+G cement was applied over it making sure the interlocking holes are left uncovered (Fig. 4). Pus was seen



**Figure 4:** 9\*34 size stainless steel tibia interlocking nail covered with 1–1.5 mm thick layer of PALACOS R+G antibiotic cement. Interlocking holes kept uncovered.



**Figure 5:** Post-operative X-rays.



**Figure 6:** Weight bearing and range of movements at 3 months.

coming out of the screw holes while reaming. A thorough intramedullary wash was given with the help of a cannula and nailing was done. The excess callus around the fracture site was not disturbed. A fibulectomy was also performed. Intra-operative samples showed methicillin-sensitive *Staphylococcus aureus*. Broad-spectrum antibiotics were

switched to culture specific, i.e., injection vancomycin. The patient was started on weight-bearing physiotherapy on day 2. X-rays were done on day 2 (Fig. 5). Sutures were removed on day 15. Discharged on oral antibiotics after 3 weeks of IV antibiotics.

#### Follow-up

The patient was followed up at monthly intervals. No complications were encountered during the follow-up visits. At 3 months, the patient was walking full weight bearing without support with full knee and ankle range of movements (Fig. 6). No signs of infection. X-rays at 3 months showed complete radiological union (Fig. 7).

#### Discussion

Established non-unions are difficult to treat [9-11]. They have a devastating effect on the well-being of the patient in terms of financial and emotional compromise [12, 13]. At the same time, it demands meticulous strategies and prolonged treatment from the treating surgeon [13, 14]. Hypertrophic non-unions are perceived as easier to treat since they are caused due to lack of fracture stability producing excess mobility at the fracture site and forming a hypertrophic callus. Thus, it can be typically solved by providing a more stable fixation [3, 15]. This was thought to be the case in our situation. However, in clinical practice, we often encounter non-unions with several concomitant causal factors. This poses a challenge to clinically diagnose septic versus aseptic non-unions, especially if it is associated with low-grade or chronic infection [9, 16].



**Figure 7:** X-rays at 3 months showing complete union.

Although an open fracture is a known cause of septic non-union, this cannot be an absolute dictum. In fact, a study by Kohlprath et al. in 2011 showed a 23% rate of aseptic non-unions in open fractures of the tibia in adults [17]. Septic non-union may be suspected pre-operatively on certain parameters namely, radiographs showing lysis, sequestering, etc., raised acute phase reactants such as erythrocyte sedimentation rate C-reactive protein [18], raised white blood count, and clinical/local signs of infection. However, all of these might be normal in subclinical infections as were in our case. Magnetic resonance imaging is sensitive but it has its restrictions in metal implanted bones. Positron emission tomography-computed tomography (PET/CT) and single-photon emission computed tomography scan has a good sensitivity of 79%, and specificity of 97% [19-21]. However, these are expensive and have availability issues. It thus becomes difficult to give a definitive diagnosis of septic non-union preoperatively in cases of subclinical infections. Thus, a malleable surgical plan needs to be devised in such cases with all the appropriate implants and trained staff [22]. Microbiological examination of the intraoperatively sampled tissue is needed to establish a final diagnosis. Local high-dose antibiotic delivery can be definitely considered in doubtful diagnosis [22]. Septic non-unions need two important factors-eradication of infection and stability to promote bony union. Conventionally, these were achieved by 2 separate procedures. However, a single-stage antibiotic nail fixation has been known to be equally effective [23] and it would reduce the complications and morbidities of 2-stage procedure. Antibiotic coated nail is especially useful, where the infection is purely intramedullary and the soft-tissue envelope around the fracture is in good condition. Another advantage of a nail is early mobilization and weight bearing. There have been many documentations of the effective use of antibiotic cement-coated intramedullary nailing for infected non-union of tibia [23, 24]. It is useful more so in refractory subclinical infections as it is known to elute antibiotics locally for as long as 36 weeks [25].

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Primary bone grafting in infected non-unions is being undertaken successfully by a lot of surgeons, however, its indications are very precise [26]. Newer artificial grafts that claim to be infection resistant have limited studies and would require radical primary debridement [26].

## Conclusion

We conclude from this case that aseptic-looking non-union in long bones can very well turn out to be a septic non-union due to subclinical infection. Pre-operative clinical, radiological, and even biochemical markers can misdiagnose such cases. Only microbiological studies of intraoperative tissue samples can give a definitive diagnosis. Pre-operative PET-CT and intraoperative frozen section is promising but not available in most centers. Thus, surgeons need to be prepared with multiple surgical options in the operating room. They should have several implants ready in their armamentarium including and not limited to plates, nails, external fixators, cement, thermostable antibiotics, etc., before operating these cases. The treatment of a potential low-grade infection should be a consideration in all non-union cases.

## Clinical Message

- Never rule out infection in a long bone non-union preoperatively. It is wise to consider a non-union as a septic one unless proven otherwise.
- Intraoperative tissue sampling for culture should be a dictum in such cases.
- Be prepared with all kinds of implants and accessories before taking on a non-union case.
- Interlocking nail coated with antibiotic cement is an effective single stage intervention which is easy to perform and economical for the management of septic non-union of tibia.



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