



A NOVEL TECHNIQUE OF THREE-PART BROKEN FEMUR NAIL REMOVAL: A CASE REPORT AND REVIEW OF LITERATURE

Orthopaedics

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ABSTRACT

Management of a non-union shaft femur with a broken nail in situ is complex and challenging. This case report describes a non-union shaft femur for 10 years presenting with a bi-segmental fracture of the femur nail. The report depicts a novel three-part broken nail removal technique and described techniques in the English literature. **Case:** The proximal fragment of the nail was removed using a conical nail extraction set. The middle segment of the nail was removed from the fracture site using pliers whereas the distal fragment of the nail was embedded in the distal femur. The stacked guide wires and hooks were not able to pass from the inner lumen of the small-sized nail. At last, the fragment was removed by forming a cortical window of 2 x 1 cm anterolaterally at the distal locking bolt site. **Discussion:** Occlusion of the nail canal by fibrous ingrowth, segmental breakage, and small canal diameter prohibited the use of conventional methods like stacked guidewires and hooks. We recommend this technique for the removal of the distal part of broken nails without intruding on the knee joint. **Conclusion:** This technique is helpful in long-standing cases of embedded three-part broken small-sized nail in the distal femur.

KEYWORDS

implant removal, non-union shaft femur, bi-segmental broken nail, small-sized nail, stuck nail

INTRODUCTION

The intramedullary interlock nailing is considered a standard operative intervention in the management of femoral shaft fracture.¹ The non-union in such cases accounts for 0.8-7.5% of the cases.² This leads to unusual stress ultimately causing breakage of the nail in nearly 4.7% of the cases.³ Management of such a complex problem is very challenging. There are various challenges involved in the removal of the broken nail and management of the non-union site. Meticulous preoperative planning is required to manage such cases.

In this case report, a bi-segmental fracture of the femur nail and the extraction techniques are described.

CASE STUDY:

A 30-year-old gentleman presented with pain in the right thigh for 10 years and an inability to bear weight on the limb for 1 month. The patient was operated on for a fractured shaft of the femur 10 years back with no postoperative complication. The patient was allowed full weight-bearing mobilization 2 months after the index surgery. The patient had a complaint of intermittent pain since then. Bone grafting along with distal bolt removal was done 2 years back. After a trivial incident of limb twisting, the patient complained of increased pain and inability to stand. The patient presented to the hospital 1 month later. At presentation, the patient was in good condition with a scar mark on the right thigh depicting closed intramedullary nailing. There was frank mobility at the mid-thigh level with no neurovascular deficit. There was a restriction of the right knee flexion with no sign of infection or compartment syndrome in the thigh. Radiographs revealed oligotrophic non-union at the fracture site with a bi-segmental broken femur nail (Figure 1). The nail was broken at fracture and D1 (proximal of two distal) locking sites. Infection at the operative site was provisionally excluded by the absence of clinical signs and the presence of normal CRP and ESR values. The patient was planned for exchange nailing and bone grafting.

The patient was operated on in the lateral position with draping till the iliac crest with an allowance of free movement of the whole limb. The proximal end of the nail was obliterated with fibrous ingrowths. After some dissection and clearance, it was made amenable for extraction by a fully threaded conical-shaped extraction bolt. The extracted segment depicted the size of 9mm x 3800mm. Various attempts of negotiating the guidewire through the middle fragment of the nail failed. The fracture site was freshened and the tissue and intra-medullary scrapings were sent for culture. The middle segment of the nail was removed from the fracture site using pliers. The canal of the middle fragment was blocked with fibrosis tissue. The distal fragment of the nail was then approached with the help of hooks and guidewire but due to the small size of the nail and fibrosis, these measures failed. The distal locking bolts were removed. The distal fragment of the nail was not even mobilized with the help of a small K-nail as it was embedded in the bone. As the distal nail fragment was stuck in the distal femur, the

plan for retrograde removal through the knee was not attempted. The chances of iatrogenic fracture and violating the knee were contemplated thus, the attempt for retrograde nail removal was not done. At last, a cortical window of 2 x 1 cm was formed anterolaterally at the D1 site with the help of drill bits (Figure 2). The distal fragment was then rotated and pushed proximally with the help of a 4.5 mm Steinman pin. As the distal end of the nail was pushed proximally above the level of the D1 locking site, a second 4.5 mm Steinman pin was inserted at this level to prevent distal migration of the nail during further manoeuvring. The long handle Kocher forceps were used to grasp the fragment.

Anterograde exchange nailing was done with an antibiotic (Gentamicin) impregnated femur nail of size 11 mm x 4000 mm (Figure 3) as a prophylactic measure against any subclinical infection. Autologous cancellous iliac bone grafting was done at the fracture site, cortical window site and distal locking site. The patient was asymptomatic since then and walking with the help of support.

DISCUSSION

Few case reports depict three-part broken nail and extraction techniques in the English literature (Table 1). In most of the cases, the proximal part of the nail was easy to remove whereas it required various techniques to remove the middle and distal parts of the broken nail.

Techniques By Previous Authors And Their Peculiarities

Maini et al.⁴ described the extraction of a three-part broken femur nail in a 42-year-old man done 2 years back. The technique involves the retrograde insertion of a 4 mm titanium elastic nail (TENS) through the broken nail from the patellar tendon. The broken nail was removed from the proximal site of the nail entry. Dubey et al.⁵ also reported a three-part broken nail in a 40-year-old male done 6 months back. The middle and distal broken pieces were removed retrogradely through the knee arthrotomy and the proximal piece was removed by jamming the reamer. Kouvidis et al.⁶ reported a three-part broken femur nail in a 35-year-old man performed 11 months back. After opening the fracture site, the middle and distal part of the nail was removed retrogradely from the knee. The disadvantage of these techniques involves violating the knee joint. There can be difficulties in making an accurate entry point through the intercondylar notch. This requires knee flexion, which was restricted in this case. The distal end of the nail in long-standing cases can be blocked by bone plugs or sclerosed bone making it very difficult to insert guidewire or TENS as in this case. Such manoeuvres can lead to iatrogenic fractures or shattering of the bone in case the distal part of the nail is stuck as in this case. Thus, such techniques were not used in this case. Sivananthan et al.⁷ described a unique technique of using a smaller-sized nail to remove the distal part of the broken nail. He reported only one case with a three-part broken femur nail out of twelve. Mazzini et al.⁸ presented a 31-year-old man with bi-segmental femur nail breakage, in which femur nailing was

done 7 months back. The fragments were removed through the fracture site with the help of cement rongeur for the middle part and a curved thin hook for the distal part. Allograft along with femur nailing was used to manage the non-union of the fracture.

The Peculiarity Of Our Case And The Challenges Involved

There were various techniques described for broken femur nail extraction. Most of the techniques involve the removal of a distal piece of the broken nail with the help of retrogradely placed guide wires/reamers through the knee.⁹⁻¹³

This case reports a uniquely challenging problem of a distal fractured fragment of the nail being struck in a bi-segmental broken femur nail, done 10 years ago. Such a long-standing complex problem was not reported in the literature yet. The two main challenges, in this case, involved the removal of the implant and surgical correction of the aetiology of the non-union. The etiological factors include inappropriate size femur nail, improper reduction and subclinical infection. To tackle all the problems, antibiotic-coated titanium femur nail of appropriate larger size along with bone grafting from the contralateral iliac crest was planned.

Extraction of a 10-year-old femur nail, broken at two sites poses a surgical test. The proximal part of the nail was easily removed whereas the distal parts were embedded in the distal femur. The size of the nail was small depicting 9mmx 3600 mm. The distal two parts were stuck in the femur canal. The long-standing fibrosis in the canal of the nail and the small size of the nail prohibited the passage of guidewire or hooks. Even at the end of the nail was blocked by a bone plug or sclerosed bone. The middle part of the broken nail was removed from the fracture site with the help of a larger size hand reamer (11 mm). The author doesn't want to violate the knee joint to remove the distal-most fragment which may lead to knee pain, cartilage and ligament damage, stiffness of the joint and chances of infection. As in this case, the knee flexion was pre-operatively restricted making the retrograde removal of nail difficult as well as posing a high risk of knee stiffness post-operatively. Thus, an innovative idea of forming an anterolateral oval cortical window at the level of the D1 screw (proximal one of the distal bolts). This small window gave a chance to push the distal part of the nail proximally with the help of a Steinman pin. A similar technique was implemented by Zhao et al.¹⁴ making the bone window distal to the distal end of the short proximal femur nail. This was followed by antegrade antibiotic coated appropriate size nail insertion along with bone grafting. The cortical window was also filled with bone graft and united well without forming any stress risers. This technique helps to extract the fractured small-sized stuck femur nails without damaging the knee joint. Due care was taken not to cause an iatrogenic fracture at the bone window site. The distal locking was done with two screws which were distal to the bone window.

CONCLUSION

We recommend this technique for the removal of the distal part of a small-sized broken femur nail without violating the virginity of the knee joint. This technique is helpful in long-standing cases of broken small-sized nails embedded in the distal femur. This surgical technique doesn't require various instruments and other implants. The broken nail extraction can be a tricky surgery, the surgeon should be well-equipped with all types of surgical techniques in his armamentarium. Acknowledgement: The authors are thankful to Dr Shivali Arya, Senior resident, Government Medical College and Hospital, Chandigarh for drawing the illustration.



Figure 1: Pre-operative radiograph

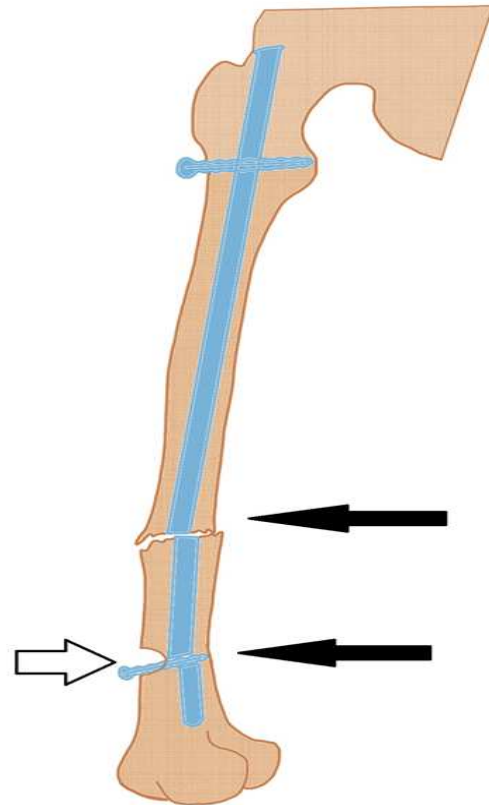


Figure 2: Illustration depicting the plan of the surgery. (Solid Black Arrow) Depicts the breakage site of the nail and (black hollow arrow) depicts the cortical window around the bolt



Figure 3: Post-operative radiograph

Table 1: Literature Depicting Various Three-part Nail Removal Techniques

S.No	Study	Year	Study type	Broken Nail Morphology	No. of cases	Extraction Technique
			Case report/ case series	Defines the two sites (Proximal and distal) of broken nail with respect to screw or fracture site		Proximal (P) Middle (M) Distal (D)
1.	Sivananthan et al. ⁷	2000	Case series of 12 cases of broken nail	Proximal- fracture site Distal- 2-3cm proximal from the D1 bolt	1	P-Pulled out from proximal entry M & D- A 3mm smaller diameter nail than the broken nail is passed over the guide wire down the intra-medullary canal and impacted into the opening of the remaining distal fragment of the broken nail. Both nails (broken distal nail and the smaller nail) are then pulled out.
2	Kouvidis et. al. ⁶	2009	Case report	Proximal -fracture site Distal – D1 bolt	1	P- Proximal fragment removed by pulling from proximal entry. M & D- Pushed out distally through an entry made in intercondylar notch via the knee joint.
3	Maini et. al. ⁴	2009	Case report	Proximal-fracture site Distal– D2 bolt	1	Elastic nail inserted in retrograde manner inside the broken nail and pulled out from the proximal entry point
4.	Mazzini et. al. ⁸	2009	Case report	Proximal- fracture site Distal- 3-4cm proximal to distal locking site	1	P-Pulled out from proximal entry M-Pulled out from fracture site using a rongeur for grasping D-Pulled out from fracture site using a curved thin hook insertion
5.	Dubey et. al. ⁵	2013	Case report	Proximal-fracture site Distal – D1 bolt	1	P- From proximal entry site using a jammed reamer technique M-Retrogradely using reamer and guidewire D- Removed distally through the knee.

D1 screw: Proximal screw out of two distal screws**REFERENCES:**

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