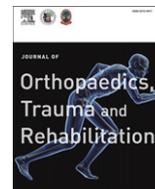




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## Case Report

# Removal of a Broken Intramedullary Femoral Nail by Transarticular Retrograde Technique—A Case Report and Review of Literature 拆除股骨內已折斷的骨髓內釘—經膝關節逆行技術之病例報告及文獻回顧

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## ABSTRACT

We report a 20-year-old Chinese female who presented with severe limping because of nonunion of her right proximal femoral fracture. The radiographs showed an intramedullary femoral nail fractured through one of its proximal locking holes. We successfully treated her by exchanging the intramedullary nail and grafting with autogenous bone. A transarticular retrograde technique was employed for the removal of the broken nail since it could not be removed by standard conventional techniques.

## 中文摘要

本文報告一名20歲中國籍女子因患有近端股骨干骨折不愈合而引致嚴重跛行，X光照片顯示股骨交鎖骨髓內釘在近端鎖釘孔處折斷。我們成功使用調換新的交鎖骨髓內釘並予以植骨治愈她。因為傳統的方法無法順利地拆除已折斷的骨髓內釘遠端部份，所以我們最終應用了經膝關節逆行技術把遠端的骨髓內釘拆除。

## Introduction

The success of treating femoral fractures by interlocking intramedullary nail (IMN) is well established.<sup>1</sup> Implant failure, such as breakage of the nail, is an uncommon complication. It is usually associated with delayed union or nonunion of fractures. Other contributing factors include the design of the implant, location of the fracture, stability of fracture fixation, infection, and the protocol of rehabilitation.<sup>2</sup> Although rare, once it occurs, removal of the broken nail is not always simple or even impossible.

## Case Report

A 20-year-old Chinese female student had a road traffic accident in Philippines at her age of 17 and sustained a closed fracture of her right femur and left ulna. The ulnar fracture was treated by open reduction and plating, whereas the femoral fracture was fixed with an interlocking IMN in Philippines. She complained of persistent limping after the surgery. Delayed union of the femoral fracture and broken IMN was discovered 5 months post-operatively. We believed that the cause of the nonunion in this

patient was the result of suboptimal implant, inadequate fixation, and improper rehabilitation. The previous surgeon used a thin IMN and did not perform distal locking, yet advocated aggressive rehabilitation. Excessive movement at the fracture site and the nonunion was therefore inevitable. However, her doctor decided for conservative management.

Because of the persistent symptom, she returned to Hong Kong 3 years after the first operation for further management. Besides limping, she had no right thigh pain. She could walk with a stick for 2 hours. However, she could not walk unaided. Examination showed a Trendelenburg gait and the Trendelenburg sign was positive. There was a 1.5 cm shortening of her right lower limb. The range of motion of her right hip and knee was full. She had 80° of external rotation of her both hips but with an excessive right hip internal rotation of about 80°, whereas it was 40° for the left hip internal rotation. The excessive internal rotational motion occurred at the pseudoarthrosis of the nonunion site. The muscle power of her right hip abduction was grade 2/5 only. There was no neurovascular deficit. The radiographs of her right femur showed nonunion of fracture in the proximal shaft fixed with an intramedullary locking nail, which was fractured through the lower proximal locking hole. The two proximal locking bolts were *in situ* but without distal locking screws (Figure 1). All the inflammatory markers were normal.

Because of the persistent symptoms, we planned to revise the fracture fixation by exchanging the broken nail with another IMN.

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**Figure 1.** Radiographs showed the fracture of proximal shaft of right femur with evidence of nonunion, intramedullary nail was broken at the lower proximal locking screw hole.

However, we could not obtain any information concerning the original IMNI and some difficulty was expected. The locking screws and the proximal part of the broken nail were easily removed. It was an unslotted cannulated nail. We encountered some difficulty in the removal of the remaining distal broken nail. The inner diameter of this unknown nail was very small and our hooks were too large to pass through the broken nail. Multiple guide wires technique also failed as it was impossible to jam more than one wire in. Moreover, because of the formation of sclerotic bone around the tip of the nail, we could not pass the guide wire through the distal nail tip to facilitate nail removal. Removal of the nail through the nonunion site was deemed too difficult since more than 3 cm of the distal fragment of the nail was lodged in the proximal bony fragment. Eventually, we decided to proceed with transarticular retrograde technique for the removal of the broken nail through a medial parapatellar arthrotomy. The knee was slightly flexed to 30°. Medial arthrotomy was performed and the medullary cavity was opened through the intercondylar notch with an awl. Under fluoroscopic screening, an 8-mm Kuntscher nail was inserted into the medullary cavity until it reached the tip of the broken nail. By hammering the Kuntscher nail, the broken nail was driven out through the proximal wound in the hip.

A Russell Taylor reconstruction nail was then inserted with locking at both ends. Autogenous bone graft was harvested from the right iliac crest and applied around the nonunion site. The tissue at the nonunion site showed negative culture result. At 4 months after the operation, nonunion fracture healing was noticed on the radiographs and the union consolidated at 8 months. (Figure 2) She could walk unaided without limping or limitation. Clinically, there was 1 cm shortening in her right lower limb. She enjoyed full range of motion in her right hip and knee. The internal rotation of her right hip was 40° and became normal. The abductor power was almost full. The interlocking nail was removed 20 months after the surgery.

## Discussion

Implant removal after fracture healing is not always an easy job. Removal of an IMN can be particularly challenging and the removal



**Figure 2.** The nonunion has healed and consolidated at 8 months (upper radiographs). The nail was removed at 20 months (lower radiographs).

of a broken one can be extremely difficult. However, it becomes a necessity in nonunion of fractures. Bypass fixation with an Ilizarov ring fixator, leaving the broken piece *in situ*, has been used for more distal femoral nonunion with success.<sup>3</sup> However, it is not applicable for proximal femoral nonunion with a long broken distal nail portion.

The literature does offer many ingenious methods for their removal. The "AO" group recommends extracting the proximal fragment, followed by over-reaming of the medullary canal down to the distal nail fragment. A long extraction hook is then used to extract it.<sup>2</sup> Other described methods include using the modified Kuntscher reaming guide; Ender's nail; hand reamer; femoral head cork screw extractor; smaller nail impaction; grasping device, such as forceps; or multiple guide wires wedged into the nail cavity.<sup>2,4,5</sup> The principle is to make a tight fit engagement in the distal nail and then the broken nail is pulled out. It may work for the AO nails and the like, with slot and relatively large central canal. However, many new nails with different designs have emerged. Some of these nails are unslotted with very narrow central canal. This technique of tight fit engagement does not work for them.

For nails with narrow central canal, Marwan and Ibrahim<sup>6</sup> passed a 1.4 mm cerclage wire down the broken nail and retrieved it through the distal locking hole with another loop of wire. The cerclage wire was folded a few times to block the nail hole and the broken nail was removed together with the wire. This method sounds simple and no special instrument is required, but it is easier said than done. The wire can slip and the folded wire may become an obstruction itself in the narrow medullary cavity.

Some manufacturers have designed special instrumentation to tackle this difficult problem. The Synthes extraction kit is able to extract the distal broken nail even if it is a solid nail.<sup>7</sup> Over-reaming proximally is needed. However, this special instrument is not available in every hospital. Krettek et al<sup>8</sup> described the removal of

a broken solid femoral nail using simple push-out technique. He opened a lateral cortical window in the distal femur and inserted a narrow Hohmann retractor beneath the tip of the broken nail, using the retractor as a shoehorn to guide the broken nail out when it was pushed from above. This technique was not suitable in our case because of the greater length of the distal nail fragment.

Retrograde techniques, such as those described by Maini and Jain<sup>9</sup> and Magu et al<sup>10</sup> were not applicable to our case as the distal tip of the broken nail was blocked by a pedestal of sclerotic bone. Although our retrograde push-out technique involves more soft tissue dissection through a parapatellar arthrotomy, it is a safe and direct approach to tackle this difficult problem. We made use of the Kuntscher nail as an instrument to successfully remove the broken nail with extremely lower morbidities and complications just like retrograde intramedullary nailing of femur. However, there is a theoretical risk of subsequent knee stiffness and patellar mal-tracking if appropriate repair is not performed.

In conclusion, there is no simple or easy way to remove a broken IMN and no universally successful technique for every situation. Every surgeon should equip himself with all the available armamentarium and techniques when tackling this challenging problem.

Transarticular retrograde technique is one of the useful tools, which the surgeons should bear in mind.

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