

Case Report

Stuffing the nail: A simple technique for the extraction of a broken femoral nail

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ABSTRACT

The extraction of broken femoral nails can be a challenging procedure and surgeons should be familiar with many different techniques. This paper demonstrates a case study and new, simple and cost effective technique for the removal of broken cannulated femoral nails. Our technique uses two guide wires of variable diameter and had several key points of differentiation from previous methods. Firstly, stuffing the nail with guide wires of greater total diameter than the cannula; secondly, reversing the second guide wire and finally, bending the tips of the wires. These innovations allow the technique to be used for narrow cannulated nails, superior purchase along the length of the nail, easy wire insertion and limited soft tissue damage. Our technique for the removal of broken femoral nails is quick, effective, cheap and easy to replicate and can be used by any generalist orthopaedic surgeon with basic equipment.

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Introduction

Extraction of broken distal segment femoral nails in the setting of femoral fracture non-union can be a challenging procedure. Femoral shaft fractures treated with reamed intramedullary (IM) nailing have union rates of 97% to 100% [1] and have several biomechanical advantages over internal fixation with plates [2]. However, in the setting of non-union, the cyclic stress placed on the nail at the non-union focus can result in fracture of the IM nail. Due to implant fatigue, apparently intact nails can break on extraction, with 5 in 60 femoral nails in one study [3] broken at the time of removal.

Whilst intact IM nails are ideally extracted using implant specific threaded extraction bolts, this method requires intact proximal nail threading which is absent in broken femoral nails, making their removal often problematic. Many methods for removal of broken femoral nails have been previously described [1–10], including custom made and long hooks, proximal stacked wires, anterograde parapatellar exchange nailing, pin and nail wedging, smaller nails, multiple guide wires, vise grip pliers and high speed drills (Table 1). Whilst our method follows in the tradition of Middleton's multiple guide wires technique described in 1995 [10], there are several important differences. In this paper we present a classic case study and the simple, effective method used for the retrograde removal of the distal segment broken femoral nail. To our knowledge this technique has not been described before.

Case presentation

A 65-year-old female patient was first admitted in February 2014 for a left femoral subtrochanteric stress fracture on a background history of osteopaenia, rheumatoid arthritis, previous bilateral Total Knee Replacements and a right neck of femur fracture

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Table 1

A brief summary of the relative strengths and weaknesses of current key techniques.

Technique	Strengths	Weaknesses
Multiple guide wires (Middleton)	Can use distal buried nails, original wounds, imaging not necessary	Poor purchase, not for narrow nails
Custom long hooks (Acharya, Franklin, Zimmerman)	Can use distal buried nails, original wounds	Need large medullary para-implant conduit to pass hook wire, requires imaging
Corkscrew extractor (Wise)	Original wounds, simple	Specialised equipment, need good purchase in nail, not for distal buried nail
Proximal stacked wires (Weinrauch)	Narrow/solid nails, non-patent proximal threads, no imaging	Proximal lag screw holes must be intact and no distal failures
Parapatellar exchange nailing (Rodney)	Retrograde nails, can use solid nails	Additional wounds/scarring, potential damage proximal femur
Pin and nail wedging (Steinmann)	Distal buried hollow nails unreachable by extractor	Additional wounds/scarring, not adjustable to nail diameter, requires imaging
Nail to nail displacement (Haba, Sivannathan)	No requirement to open non-union site, solid nails	Broken fragment removed via parapatellar incision, additional wounds/scarring
Vise grip pliers (Yoslow)	Original wounds, simple	Poor purchase and strength of removal, specialised equipment, not for distal buried nails
High speed drills (Georgiadis)	Original wounds, can use on distal buried nails	Risk of tissue injury by drill, cost and access to equipment
Cerclage wire (Marwan)	Low cost and easy access to equipment, original wounds	Difficult to perform, wire slippage and obstruction

18 months prior treated with two cannulated screws. Three days later the patient underwent a left femoral open reduction and internal fixation with an intramedullary nail. The operation was uncomplicated and a Smith and Nephew 34 cm × 11.5 mm reconstruction nail was inserted with two proximal locking screws. Metastatic and metabolic causes of the fracture were excluded and the patient was discharged to weight bear as tolerated.

One year later, she was referred by her general practitioner to the Emergency Department following sudden left hip pain on twisting whilst washing the dishes. X ray imaging confirmed a broken left IM nail at the level of the second proximal locking screw in the setting of a non-united sub-trochanteric fracture. Review of imaging confirmed the non-union of the original fracture at the last outpatient follow up in December 2014 (Fig. 1). However, this was not addressed at the time and cyclic stress had now caused the nail to break. In March 2015 the patient underwent a successful Removal and Replacement of Broken Left Femoral Intramedullary Nail.

Technique

On a supine traction bed two incisions are made over the subtrochanteric region and the greater trochanter over the original scars to allow removal of the two locking screws and the proximal broken segment of the nail. In this case, the nail in situ is a Smith and Nephew cannulated IM 34 cm × 11.5 mm nail with an internal diameter of 5.5 mm. Two long guide wires are selected

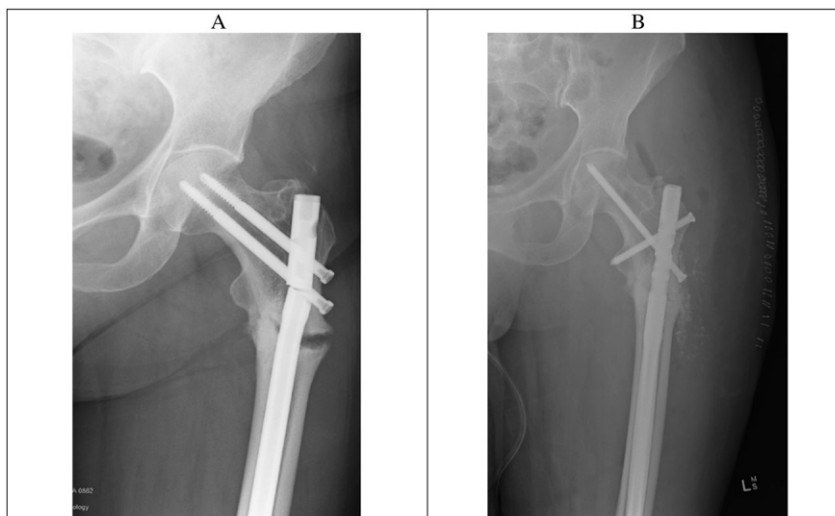


Fig. 1. A: Radiograph on admission March 2015 showing broken IM nail and femoral shaft fracture non-union B: follow up radiograph post exchange femoral nailing March 2015.

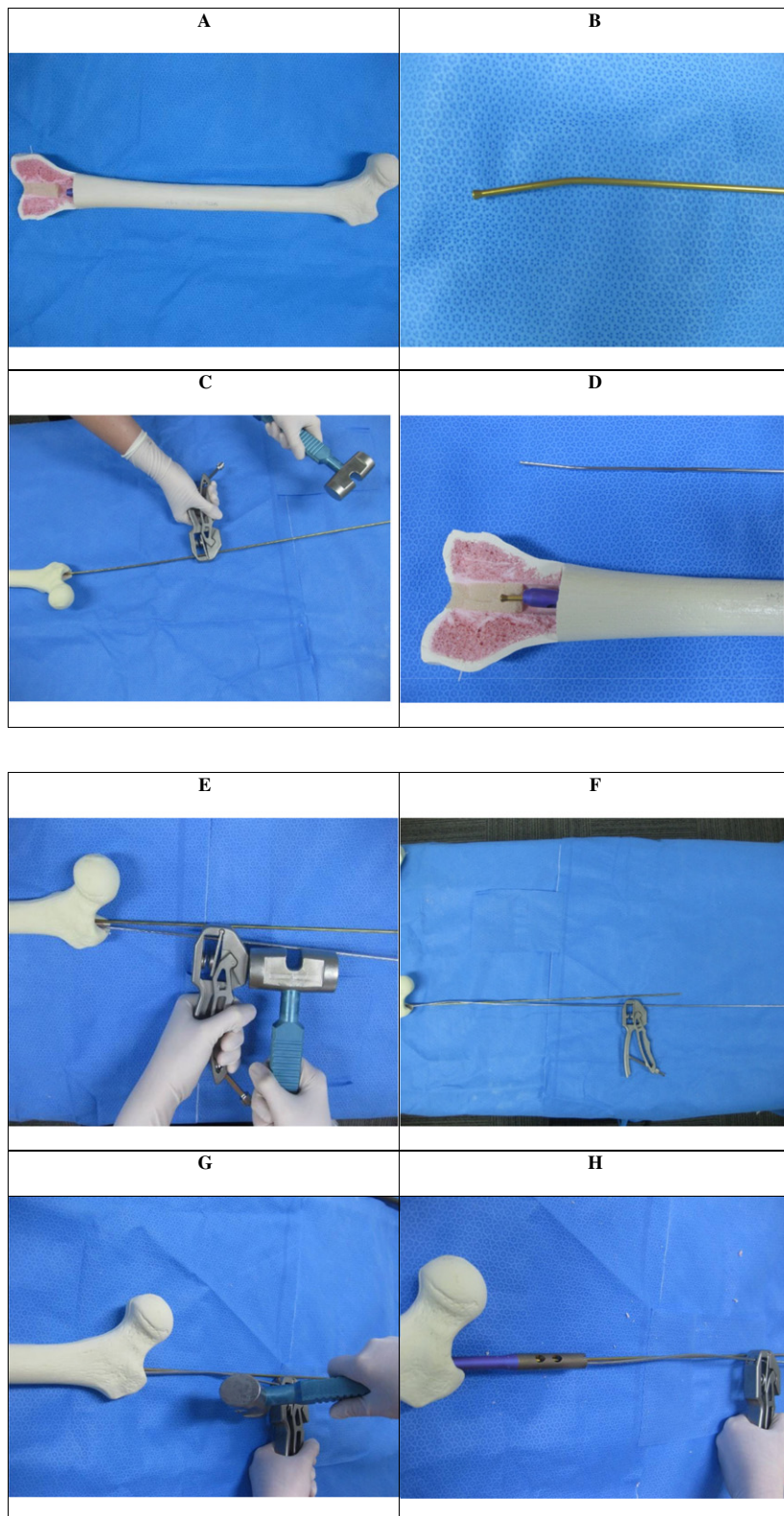


Fig. 2. A: Femoral bone with 34 × 11 mm IM nail, 5.5 mm internal diameter B: first long guide wire bent 10° at olive tip end C: first long guide wire inserted and struck down IM nail using mallet and wire grasper D: first long guide wire protruding from distal end of femoral nail. Second guide wire bent 10° at pointed end E: second guide wire struck down IM nail cavity F: photo demonstrating length of second guide wire in femoral nail compared to first guide wire G: mallet reversed and second guide wire struck to remove apparatus H: both guide wires and nail easily removed as one unit from bone.

whose combined diameter is 0.5 mm greater than the IM nail internal diameter. In this case, 2 × 3 mm long guide wires are used. One 3 mm long guide wire is bent approximately 5 cm proximal to the olive tip end to 10° and the other wire bent to 10° 5 cm proximal to the pointed end. The first guide wire is then inserted olive tip first into the remaining broken nail under Image Intensifier (II) guidance. The bend allows accurate insertion into the nail cavity using a simple twist after initial II as it is often difficult to visualise the proximal end of the broken nail. Once in the inner cavity, the guide wire is progressed until it protrudes 1 cm at the distal end. A wire grasper is then fed up the second guide wire prior to insertion into the proximal end of the nail with the pointed end. A mallet is then struck against the wire grasper to force the second guide wire into the nail until it cannot progress any further. We found this to be around the mid-way point of the nail. At this point, the mallet is reversed and, whilst striking the other side of the grasper, both guide wires and the nail all come out together in a few strikes (Fig. 2).

Discussion

The failure of intramedullary implants in the setting of non-union can represent a problematic operation for surgeons due to the inability to use implant specific extraction devices on the distal segment. Given the wide variety of implants in use, both solid and hollow nails with and without extraction slots, it is important for the surgeon to be familiar with a wide range of different techniques. Many techniques for removal of hollow intramedullary nails have been previously described [1–10].

The key differences from the standard multiple guide wires technique [10] are threefold. Firstly, the guide wires selected have a combined diameter greater than that of the nail cavity, ideally 0.5 mm greater as in our case illustration. This results in jamming of the second guide wire in the cavity and allows both wires and the nail to be removed easily as one unit on extraction. It also allows the technique to be easily adjusted for many different nails according to the internal diameter of the nail. Secondly, this method reverses the second guide wire so that the pointed end is inserted as opposed to the olive tip ends [10]. This allows the method to be used in narrow diameter hollow nails and for purchase of the nail along the length of the second guide wire, not solely at the olive tip ends which can easily slide. Finally, the guide wires are bent to allow ease of insertion into the proximal nail cavity which is often unable to be visualised under direct vision and can be particularly difficult in narrow cavity nails. After initial imaging of the wire at the proximal end, an appropriate twist allows it to slide easily into the nail cavity. In addition, the scarred incisions from the original nail are used, limiting soft tissue damage, post-operative pain and scarring to the patient.

Our simple technique can be used for all cannulated nails and is easily adjusted for varying internal nail cavity diameters. It does not require any specialised equipment, is cost effective and can be easily performed in centres with limited resources by a generalist orthopaedic surgeon. Limitations for this technique include use in solid nails, and the technique may be difficult where there is bony ingrowth or a very tight isthmus and nail interface. Due to the many different types of nails and patterns of failure, the surgeon should be familiar with many different methods of broken nail extraction, and our technique can be considered a useful addition to that repertoire.

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