

Femoral intramedullary nail extraction using the kissing nail technique when primary measures fail

Joseph Brenner, BS^a, Jonathan Joiner, DO^b, Eric Schweller, DO^c, Emily Ren, MD^d, Kerellos Nasr, MD^d, Rahul Vaidya, MD^d

Abstract

Introduction: Intramedullary femoral nails (IMFNs) need to be removed for subsequent joint replacement, refracture, nonunion, or infection. The tools used to extract newer IMFNs may not be suited for removal of older implants, especially if broken. The purpose of this study was to describe a novel technique in femoral nail extraction when primary measures fail and a report on 6 cases where it was used.

Technical Procedure: The technique is used after standard techniques including the Winquist set fail. A guide rod is passed through the center of the incarcerated nail (IN) to the distal end or to the proximal end if it is a retrograde nail. The femur is approached through a separate incision either through the knee for an antegrade nail or through the proximal femur for a retrograde nail. The guide rod is delivered through the opposite end by either hitting it through the end of the bone or breaching the end with a starting wire and starting reamer. The guide rod is then delivered into the field. Using flexible reamers over the delivered guide rod, the femur is reamed up to the IN. A second IMN slightly smaller in diameter is chosen and passed to touch the distal end of the IN, guided by the guide rod to keep the nails aligned. The second nail is impacted, which pushes the IN out its insertion point.

Discussion: Hardware extraction is difficult for any surgeon, and extraction of older or broken nails with lower grade material poses even greater challenges. This technique is meant as an extra tool for avoidance of corticotomy when primary means for nail extraction have failed. We present 6 cases with 5 successful results.

Key Words: trauma, hardware removal, intramedullary nail, nail extraction

1. Introduction

The history of intramedullary fixation in the setting of long bone fractures has played an integral role in the advancement of orthopaedic surgical care. EWH Groves first described the technique using railroad ties in the early 1920s,¹ and Küntscher further developed the implants and technique during World War II to mitigate the attrition of German pilots.^{2,3} Hardware removal after femoral nailing is indicated for the treatment of nonunion, broken hardware, peri-implant fractures, and painful hardware or when patients become candidates for arthroplasty procedures of the hip or knee.⁴⁻⁷ Femoral nail extraction takes place with a myriad of tools at the surgeon's disposal, and corticotomy is often used when traditional tools fail.^{5,6} Increased operative time and greater bone and soft tissue disruption can lead to higher rates of infection and morbidity.⁶ The purpose of this study was to

demonstrate a novel technique for femoral IMN removal, which uses simple tools that are readily available. In addition, we present 6 cases where the technique was necessary because of failure of the usual protocol of nail removal short of corticotomy.

2. Technical Procedure

The patient is placed in the lateral recumbent position with a beanbag and the contralateral limb well padded, being sure to float the common peroneal nerve (CPN). We approach the implant through the incision of the previous surgery. Before any attempts to remove the IN, all interlocking screws should be removed using fluoroscopy and previous scars. In newer generation nails, we will use the proprietary extraction device. In an implant of unknown origin, or a known, older generation where we cannot get the implant-specific extractor device, we use

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^a University of Toledo College of Medicine and Life Sciences, Toledo, OH, ^b Department of Orthopedic Surgery, McLaren Oakland Graduate Medical Education, Pontiac, MI,

^c Department of Orthopedic Surgery, Community Garden City Hospital, Garden City, MI, ^d Department of Orthopedic Surgery, Detroit Medical Center, Detroit, MI.

* Corresponding author. Address: University of Toledo College of Medicine and Life Sciences, 3000 Arlington Ave, Toledo, OH, 43614. E-mail address: joseph.brenner@rockets.utoledo.edu (J. Brenner).

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Informed Consent: Written informed consent obtained from all patients and/or families.

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a Winquist “Christmas tree extractor” or hook from the Winquist extraction set (Shukla Medical, December 22, 2023; *Winquist III Xtract-All Nail*, St. Petersburg, FL).⁸ If the incarcerated nail (IN) just does not move despite repeated very aggressive backslapping, we next drill out all the unfilled locking holes proximally and distally to remove bone ingrowth and this has worked in several instances. If not, we move on to the kissing nail (KN) technique. In broken nails, where the proximal portion of the implant separates from the distal, we attempt to pass multiple guide rods into the nail to try to wedge the guide rod through the nail and then pull this back with a T handle chuck and a slap hammer. If this fails, or there is damage to the nail’s proximal extraction threads so you cannot attach an extraction device (ie, it is stripped), we move on to the KN technique. A ball-tipped guide rod is passed through the proximal portion of the IN into the distal tip, under fluoroscopy (Fig. 1A and B). Once the guide rod is identified past the tip of the nail, a median parapatellar approach to the knee is made to access the femoral canal. A starting wire and an opening reamer are used to access the medullary canal, and the ball-tipped guide rod is retrieved. For an incarcerated retrograde nail, the guide rod is passed from the knee proximally through the IN to the piriformis fossa. A starting guidewire is placed proximally in the piriformis fossa, over-reamed with a starting reamer, and the guide rod is subsequently retrieved proximally. This guide rod is then over-reamed with reamers up to the IN. A tibial or femoral (the KN) nail is chosen such that it is smaller in diameter than the

incarcerated implant and long enough to push the IN through the other end, the reason being that a bigger KN than the IN would require extra reaming in the canal, which is not possible and a KN of similar size might be tight. A KN of smaller diameter slides easily in the femoral canal up to the point where it “kisses” the incarcerated implant (Fig. 1C). Using the guidewire, the KN is impacted in a controlled manner (using fluoroscopy throughout to ensure that there is nail-to-nail contact) (Fig. 1C and D). If the proximal extractor is still intact, there is simultaneous effort to remove the nail from both the proximal and distal ends of the femur. Figure 1 is from Case 1, Figure 2 is from Case 2, and Figures 3 and 4 are from Case 6.

3. Results

The reason for removal in the 6 cases was planning for THA in 3 cases, broken nails in 2 (Fig. 2), and one failed mechanism in a modern nail (stripped end cap) (Figures 3 and 4). In each case, we tried standard modes of retrieval, which are listed for each case in Table 1. We were successful with the technique in 5 of 6 cases after trying multiple other techniques. In one case, we were unsuccessful while attempting to remove a Küntscher nail installed 35+ years ago because of bony ingrowth, aberrant femoral anatomy, and an antiquated, stainless-steel nail. In this case, the surgeon was not careful in ensuring that the KN and IN remained in contact (with fluoro) while impacting the KN and the guidewire slipped out of the

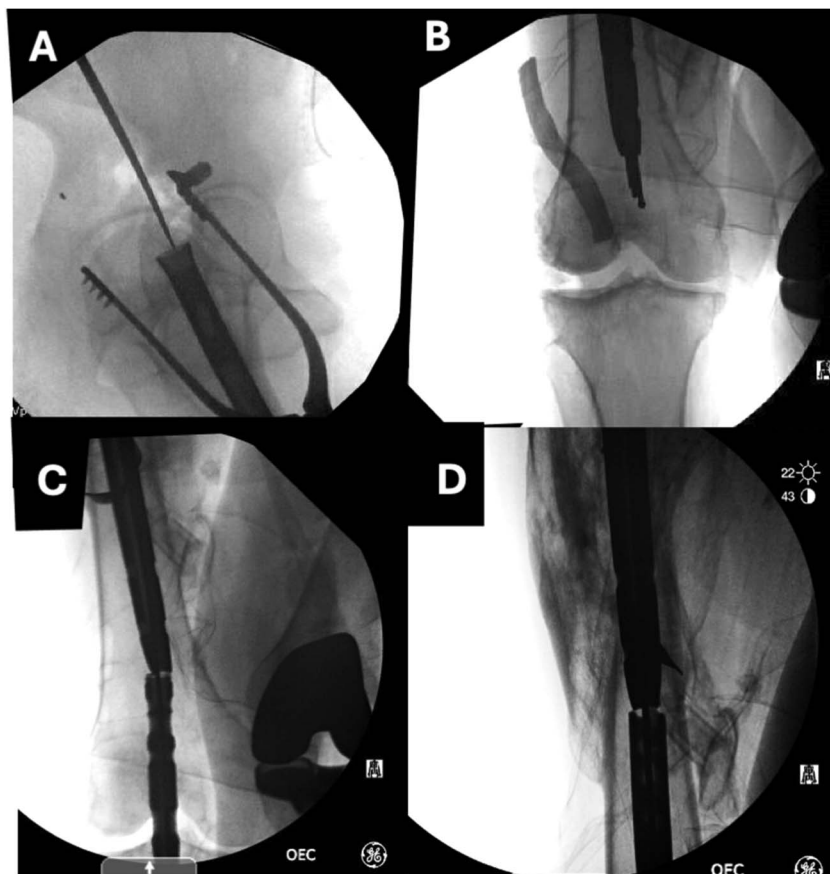


Figure 1. A, A ball-tipped guidewire being passed through the proximal end of an incarcerated nail after traditional methods have failed and we resorted to the KN technique. B, Insertion of a ball-tipped guidewire, trying to stack it for nail removal also failed. C, Using the kissing nail technique retrograde to remove the incarcerated tibial nail applied to the distal end of the femur nail. D, The tibial nail driving the femur nail up the shaft in an anterograde manner.

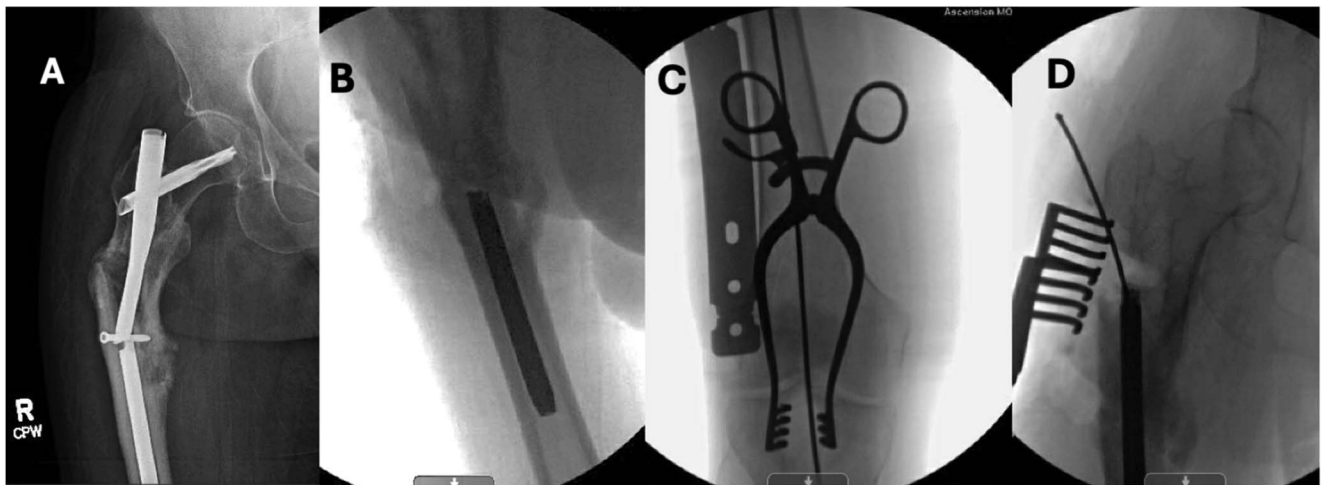


Figure 2. A, Broken intermediate nail with resultant malunion. B, After removal of the proximal piece, the distal piece remained incarcerated and despite attempts with graspers and guide rods, it would not budge. C, Kissing nail technique using a retrograde guide rod. D, Owing to the malunion, the remnant nail had to be retrieved through an osteotomy in the bone because it could not bend around the deformed canal.

IN when the KN was impacted, iatrogenically fracturing the anterior cortex of the femur. This led to an eventual corticotomy, removal of the nail, and lateral locking plate fixation. The 2 nails must always be kissing or in contact to prevent this occurrence. A modern retrograde nail (case 6) required removal for a nonunion after a nail plate construct had been used. The issue in this case was that the end cap, which is required for this technique, had been inserted too far and the head had been stripped (Figures 3 and 4). A broken screw removal set, graspers, and removing the distal femoral locking plate all failed while being used in separate attempts to remove the end cap. Using the KN for the retrograde IN was successful. We were unable to dislodge the end cap even after the nail was retrieved. This is likely not the first time that this has happened with this particular design or will happen again, another common instance the KN technique will be helpful.

4. Discussion

A method of extraction is described as an alternative when the traditional methods do not work. The nail extraction technique described above is an additional technique that can be used when all

traditional options have been exhausted. Our technique is a salvage technique and is not intended for a primary extraction, only to be used if the nail breaks distal to the extractor threads, the threads are stripped, the set is contaminated or malfunctioning, or enumerable other complications arise. This technique allows for successful nail extraction without the need of corticotomy. For nails that have a narrower lumen that does not allow for the passage of a ball-tipped guidewire, we suggest either inserting the other end of the guidewire or cutting the ball off. We advise against attempting the KN technique with solid nails, as without guidewire stabilization, there is a greater chance of the KN slipping off the IN and impacting the cortex. We do acknowledge that by performing knee arthrotomy, or proximal femoral cannulation, we increase our risk of potential damage to the articular surfaces of the patella and distal femoral condyles. We take all precautionary measures available to minimize these risks. This technique allows for smaller incisions and less soft tissue disruption when compared with the corticotomy that is often a salvage technique.

The key to the technique is maintaining contact between the 2 nails and visualizing that contact using fluoroscopy. As with any

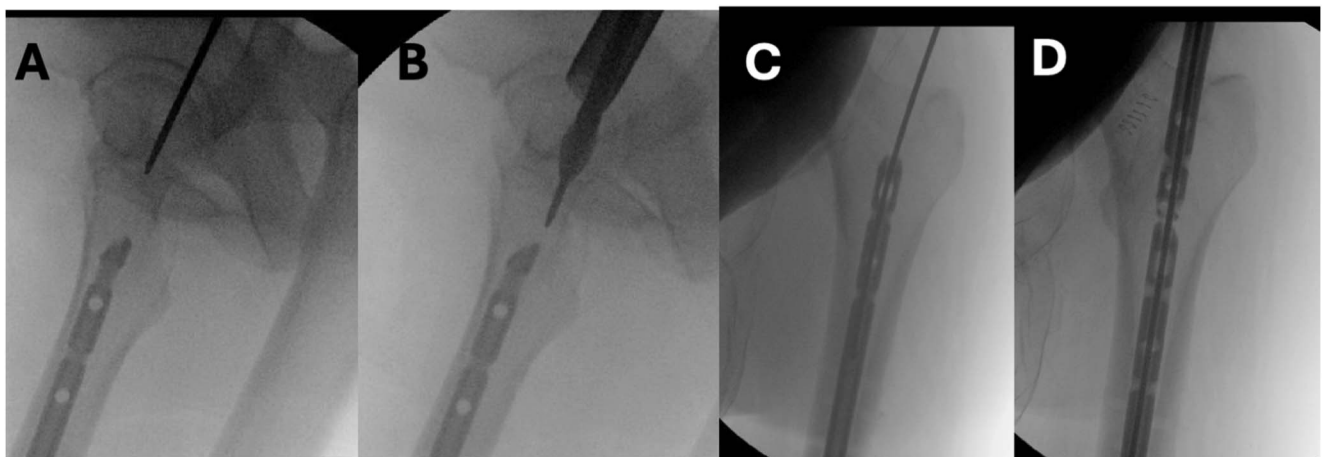


Figure 3. A, Incarcerated retrograde nail where the end cap had stripped. Opening the piriformis fossa. B, Reaming over the starting guidewire to reach the proximal end of the nail. C, Passing the guide rod through the nail and to extract it out distally.

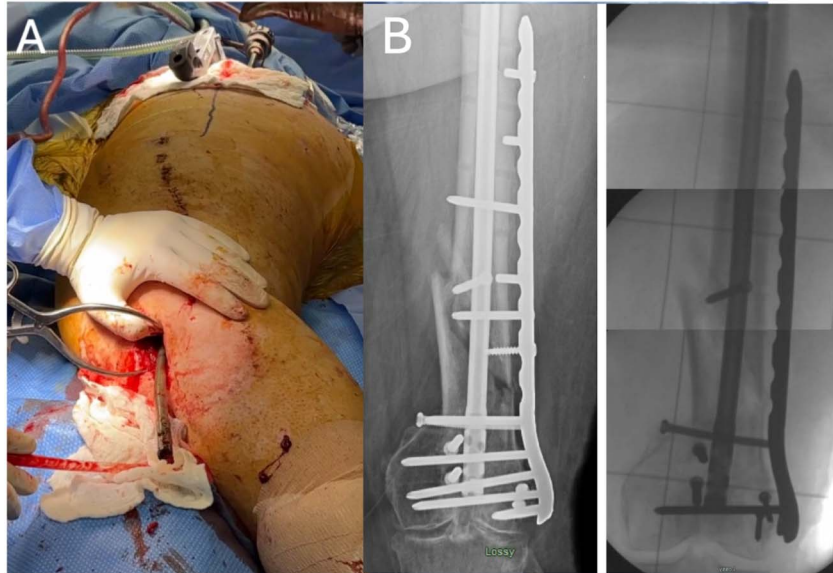


Figure 4. A, Case in Figure 3 with the stripped end cap requiring alternate kissing nail extraction technique in the lateral position. B, Preoperative X-ray of the femur with IN displaying interlocking screws that correlate with extra incisions in (A).

TABLE 1.

Details of Each Case Included in the Study As Well As Technique and Outcomes

Case	Details of the Case	Techniques Used	Comments
1	72 yo woman with 3rd-generation antegrade nail placed 15 y ago for fracture; new fall and nail fractured	Removal of the proximal piece with Winquist set, graspers, GRT, and DLH failed	KN technique retrograde successful. Renailed with new 3rd-generation antegrade nail
2	68 yo man with broken 3rd-generation nail; new fracture from fall	Removal of the proximal piece with Winquist set, graspers, GRT, and DLH failed; attempted to retrieve the remnant nail through the fracture failed	KN technique successful, retrieving the nail through the fractured femur. Renailed with 3rd-generation antegrade nail
3	74 yo with 40 yo nail needing removal for subsequent THA	Failed removal with Winquist set and DLH	KN technique retrograde successful
4	81 yo with 30+ yo nail needing removal for THA	Failed removal with Winquist set and DLH	KN technique retrograde successful
5	65 yo with 30+ yo nail needing removal for THA	Failed removal with Winquist set and DLH	KN technique retrograde unsuccessful because of improper technique, requiring corticotomy
6	48 yo woman with a retrograde nail/plate for comminuted distal femur fracture with nonunion (12 mo postop); end cap unable to be removed because of stripping in new-generation retrograde nail	Failed removal with graspers and hooks and trying to engage proximal locking holes with impactors from outside	KN technique antegrade successful

GRT, stacked guide rod technique; DLH, drilling out the locking holes; THA, total hip arthroplasty.

technique that violates a long bone canal, cortical fracture is a worry. Being certain that the KN is impacting the IN and not the cortex is of utmost importance in this instance. Delivering regular, controlled force will free the IN, and we have not experienced any cases where the force of impaction itself caused iatrogenic fracture. The KN has driven the IN safely out of the canal in each case where adequate contact was maintained. We view this technique as a valuable tool when dealing with a difficult problem that saves surgeons' time and patients' recovery.

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