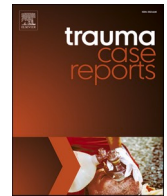




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## Case Report

# Kuntscher nail removal: Revision of a failed hip resurfacing above an incarcerated Kuntscher nail. A case report of a smart nail extraction technique through a custom-made instrumentation

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## ABSTRACT

Removal of a retained and osseointegrated intramedullary femoral nail can represent a considerable problem, especially in the case of contemporary total hip arthroplasty or, even worse, in the case of revision hip arthroplasty. Usually, complex and invasive surgical techniques are required to remove incarcerated Kuntscher nails. We described a case of an incarcerated Kuntscher nail, inserted 39 years before, in a 75-year-old woman waiting for a revision total hip arthroplasty of a failed metal-on-metal hip resurfacing. A CT-based custom-made extra-long trephine reamer was designed and successfully used to easily extract the nail, leaving the proximal femur before a revision hip arthroplasty.

## Introduction

Retained intramedullary femoral nails or other osseointegrated hardware can represent a significant difficulty, especially in the case of a conversion total hip arthroplasty (THA). Removing incarcerated, bent, broken, or buried intramedullary nails is often tricky and technically demanding. Several surgical techniques have been described [1]. Various cases of successfully performed conversion THAs in the presence of incarcerated intramedullary nails have been reported. Extensive trochanteric osteotomy, nail cutting, and implantation of a cemented short [2] or custom stemless anatomic femoral have been used to overcome the problem [3]. Troubles can be even bigger when facing a revision surgery.

Here, we describe a revised case of a failed hip resurfacing previously performed on an old Kuntscher nail. This procedure required a smart extraction technique and custom-made instrumentation.

## Case description

In 2006, a 75-year-old woman (BMI 23.4) was referred to our clinic for severe right hip pain and limitations. The primary osteoarthritis of the right hip and femoral nail fixation outcomes were immediately diagnosed at the plain pelvis radiograph. The woman in 1974 was indeed treated with an antegrade intramedullary nailing procedure using a clover-leaf design Kuntscher nail for a transverse

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shaft fracture in the right femur. Nail removal and total hip replacement were indicated. Unfortunately, nail removal was impossible at that time due to its osseointegration, and the surgery ended up with a metal-on-metal (MoM) total hip resurfacing. The patient received an ASR hip resurfacing (DePuy-Synthes) with complete clinical and functional recovery that lasted for 17 years. During the MoM THA surveillance, which occurred after the ASR recall by DePuy in 2010, the patient was found well at each follow-up visit with no clinical symptoms nor radiological signs of osteolysis or radiolucency, blood metal ion levels consistently below the 7 mm/l threshold and no pseudotumor or periprosthetic cystic formation were seen at MRI scans. The Patient left our surveillance protocol spontaneously in 2012 by her will.

In March 2023, she came back to our attention for growing pain in the right hip. On a plain radiograph, the femoral neck appeared to be fractured, and the femoral component tilted in a severe varus position. Periprosthetic osteolysis was also visible around the femoral component, suggesting a fatigue fracture and prosthetic loosening (Fig. 1).

Revision surgery with conversion to standard THA was deemed mandatory. The patient gave dedicated informed consent for the surgery and the anonymous treatment of her data for scientific purposes.

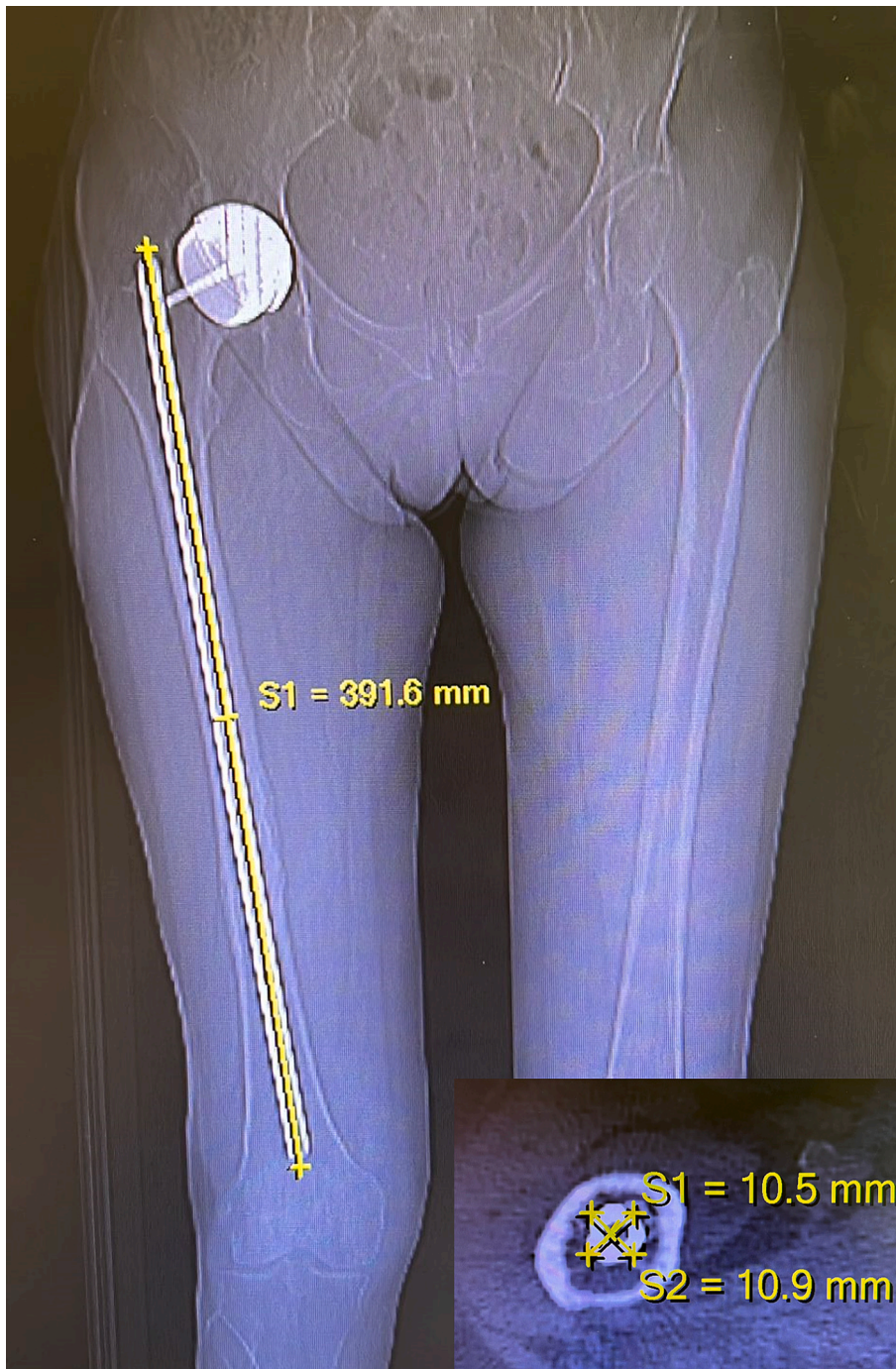
During the preoperative planning, it was clear that the nail had to be removed this time.

Even if there were some reports about specific instruments for Kuntscher nail removal (Depuy-Synthes Johnson & Johnson©, Warsaw, IN USA), those systems were too short, only 200 mm, for this specific patient. The senior Author (FR) contacted a known Company (Permedica S.p.A., Merate, Italy) to create a custom-made trephine to ream the surrounding femoral bone just around the nail, thus avoiding performing a huge anterior femoral cortical window. A CT scan was performed to measure the cross-sectional sizes of the nail (Fig. 2). A cannulated extra-long reamer (Ø11 mm x 350 mm) was designed and manufactured (Permedica S.p.A., Merate, Italy) with a hard metal alloy (tungsten carbide alloy), thermally treated at the reamer tip to enhance the hardness of the cutting edges. Fenestrations along the reamer shaft were created to allow system cooling through irrigation (Fig. 3).

A lateral approach was performed. After capsulotomy, the loosened femoral component, together with part of the femoral neck, was quickly removed. The remaining femoral neck was regularized. No metallosis was seen in the articular space, and the acetabular shell was tested for stability. Since the acetabular cup was completely stable, there was no metallosis nor blood metal ions elevation, the cup was left in place. The proximal part of the nail was identified, with the hanging hole for removal already broken in 2006 and debrided from heterotopic bone and fibrosis. A check for reamer alignment to the nail was obtained through fluoroscopic guidance. The cannulated reamer was then carefully used with subsequent passages until the femoral isthmus was surpassed, paying particular attention to the trajectory of the reamer. The nail was then easily removed with the help of a spine rod cutter (Fig. 3). A revision stem (Corail Revision, Depuy-Synthes Johnson & Johnson©, Warsaw, IN USA) was then inserted without any intraoperative complication (Fig. 4). Since the cup was left in place, it was converted to a dual mobility implant matching a suitable-sized polyethylene dual mobility insert made by the same company (Bimentum, Depuy-Synthes Johnson & Johnson©, Warsaw, IN USA). At the first-year follow-up, the patient restored complete hip function without residual pain.



**Fig. 1.** Anterior-posterior radiograph of the pelvis taken before revision surgery, showing the incarcerated Kuntscher nail and the failed metal-on-metal hip resurfacing.



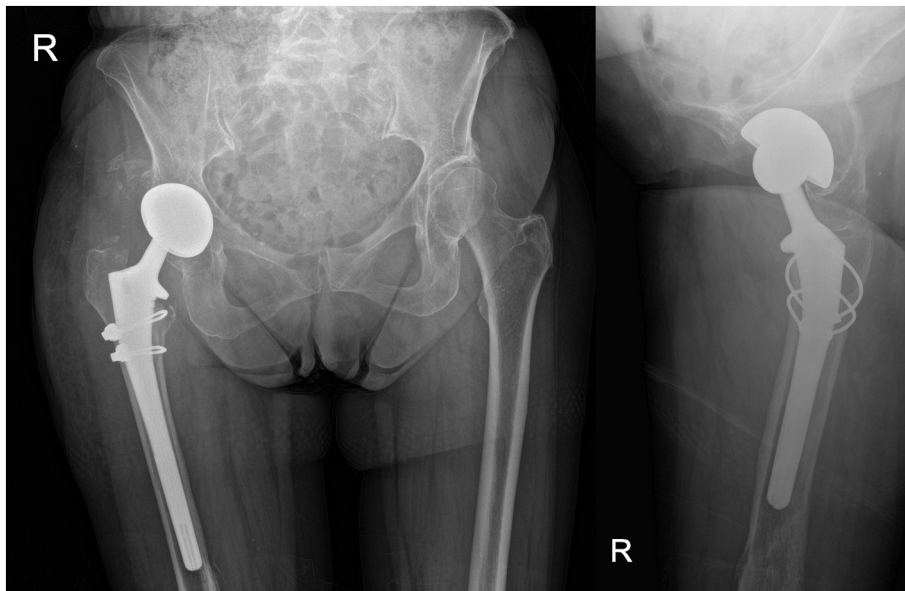
**Fig. 2.** The custom-made trephine ream length (35,0 cm) and diameter (11 mm) were based upon the Kuntscher nail length (39,2 cm) and cross-section area (10.5 × 10.9 mm) measured on a CT scan of the entire femur. The preoperative planning was to ream distally, at least beyond the femoral isthmus, where the bone callus of the healed fracture was visible.

### Discussion

The difficulty in removing an osseointegrated intramedullary nail from the femur is a historical complication [4]. Slots and open cross-sections of some nail designs allow bone ingrowth into their cavities during healing. This leads to a significant risk of a femur fracture during forced extraction attempts. Several techniques have been described to remove broken, migrated, or incarcerated intact intramedullary nails, involving often aggressive and largely invasive procedures [1].



**Fig. 3.** A: Picture of the custom-made trephine reamer. B: Intraoperative images of the custom-made trephine before insertion and during reaming. At the bottom, the removed nail is mostly osseointegrated, even distally to the femoral canal Isthmus. A spine rod cutter was used to firmly hold the remaining tip of the nail while hammering it out. Unfortunately, the original dedicated hanging hole for nail removal was already broken at the time of resurfacing.



**Fig. 4.** Shows an Anterior-posterior radiograph of the pelvis taken at a one-year follow-up. It shows the revision collared Corail stem and the conversion to dual mobility hip arthroplasty, leaving in situ the old acetabular CoCr shell. A couple of precautionary cerclages were used just below the osteotomy to avoid any possible periprosthetic fracture since the thinning of the femoral cortex was caused by trephine reaming.

Longitudinal osteotomy of the lateral cortex in the proximal third of the femur and tibia was described to decompress the canal and allow an even more difficult removal of incarcerated Kuntscher nail [5,6]. Recently, other more invasive techniques were described to remove Kuntscher nails using two incisions and a longitudinal femoral osteotomy with a Gigli saw wire across two bony windows throughout the entire nail length or through retrograde hammering across the knee [7,8].

The literature describes one periprosthetic intertrochanteric femoral fracture after hip resurfacing above a retrograde intramedullary nail, which required a similar technique to remove the nail, as described in this article. The fracture was treated by removing the retrograde intramedullary nail using a cannulated opening drill through a guide pin placed into the intercondylar notch to remove the bony growth over the nail, allowing its extraction with a nail extractor. Secondly, the fracture was stabilized by implanting a Gamma3 cephalomedullary nail [9]. However, the resurfacing implant did not require a revision or conversion to a standard THA.

We have found no case of hip resurfacing revision in the literature after intramedullary femoral fixation or plate. In 2018, Pritchett reported no failures or revisions in his series of non-MoM hip resurfacing performed in patients with osteoarthritis after intramedullary nailing or plating for femoral neck or shaft fractures [10].

Using trephines as an extraction system is an infrequent technique for Kuntscher nail removal. Recently, it has been reported as an alternative method to remove Kuntscher nails in three cases requiring conversion to THA. The difference with our custom-made system is the length of the trephine and the manufacture. Our custom-made one is 150 mm longer [11].

The peculiarity of our case is the idea of using a modified trephine surgical reamer with a customized length (350 mm) instead of the standard 20 cm length to go distally beyond the femoral isthmus and gently reaming the bone ingrowth and overgrowth around the entire length and surface of the Kuntscher nail. This simple and smart solution facilitated its removal without extensive longitudinal femoral osteotomies or other aggressive procedures, which would have caused femoral fractures or other complications leading to a more difficult recovery, particularly after a revision hip arthroplasty. If a femoral osteotomy were performed, for instance, immediate weight bearing would be mandatory deferred, and the time and uncertainty of union and the more complex revision of the failed hip resurfacing are to be considered [12,13].

## Conclusion

In the case of an incarcerated straight intramedullary nail, as Kuntscher one, we recommend, as a possible removal technique, using an extra-long custom-made surgical trephine reamer to release the nail before its extraction.

This effective method does not require invasive techniques and considerably reduces possible intraoperative complications and patient recovery time.

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## Ethical approval

The study was conducted following the Declaration of Helsinki.

## Informed consent

Informed consent was obtained from all subjects involved in the study.

## CRediT authorship contribution statement

**Filippo Randelli:** Conceptualization, Investigation, Methodology, Writing – review & editing. **Lorenzo Banci:** Methodology, Software, Writing – original draft. **Ornella Visentin:** Conceptualization, Investigation, Writing – original draft. **Danilo Di Via:** Data curation, Software, Validation. **Alberto Fioruzzi:** Data curation, Formal analysis, Investigation, Validation.

## Declaration of competing interest

F.R. has nothing to disclose.

L.B. is employed by Permedica S.p.A.

O.V. has nothing to disclose.

D.D.V. has nothing to disclose.

A.F. has nothing to disclose.

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