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Retrieval of a Broken Cannulated Drill Bit from the Femoral Neck during Proximal Femoral Nailing: Case Report of a Novel Lever Technique Using a Depth Gauge

Rakshith N Patil[1], Vikram G K Bhat[1], Naman Mittal[1], Akshit Khandelwal[1], Sudhanva G N[1]

Learning Point of the Article:

Intraoperative drill bit breakage need not necessitate extensive dissection or specialized retrieval devices, and the depth-gauge lever technique offers a simple, cost-neutral method and readily available solution for the same.

Abstract

Introduction: Intraoperative drill bit breakage is a recognised complication in orthopaedic trauma surgery. Although retained broken drill bits embedded deep within bone are generally considered benign, their removal becomes mandatory when they obstruct optimal implant placement for fracture fixation, risk migration, or carry medicolegal implications.

Case Report: We describe the case of a male patient in his mid-sixties who sustained a left intertrochanteric femur fracture and underwent proximal femoral nailing (PFN). During reaming for the compression screw, an 8 mm cannulated drill bit fractured and became lodged within the femoral neck over the guide wire. A novel lever technique using a standard PFN-set depth gauge was employed. The hooked tip of the depth gauge was passed through the lumen of the broken cannulated drill bit under fluoroscopic guidance. The instrument was then rotated so that the hook faced medially, and the external arm was levered laterally away from the limb to engage the hook firmly against the medial wall of the broken fragment. Gentle traction successfully retrieved the drill bit, allowing completion of fracture fixation with a new drill bit in the optimal tip-apex position.

Conclusion: This technique is safe, reproducible, and time-efficient. It requires no additional incisions, no specialized instrumentation beyond the standard PFN set, and provides secure mechanical engagement of the fragment before extraction. We recommend this approach for similar intraoperative situations.

Keywords: Broken drill bit, femoral neck, retrieval, depth gauge, proximal femoral nail, intertrochanteric fracture, lever technique

Introduction

Intraoperative instrument breakage is a recognised complication in orthopaedic and trauma surgery. Among all instruments, drill bits represent the most frequently broken, a finding attributed in part to the practice of reusing them across multiple procedures. Pichler et al. reported an overall instrument breakage rate of 0.35% across 11,856 procedures, with none of the patients experiencing significant long-term sequelae from retained fragments [1]. A larger study by Haberal and Beyaz involving 12,601 procedures found a breakage rate of 0.28% overall, rising to 0.64% specifically in fracture fixation – 7.44 times higher than in elective surgery [2]. Price et al. further demonstrated that drill

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Dr. Rakshith N Patil


Dr. Vikram G K Bhat


Dr. Naman Mittal


Dr. Akshit Khandelwal


Dr. Sudhanva G N

[1]Department of Orthopaedics, Kasturba Medical College Mangalore, Manipal Academy of Higher Education, Manipal, India.

Address of Correspondence:
Dr. Naman Mittal,
Department of Orthopaedics, Kasturba Medical College Mangalore, Manipal Academy of Higher Education, Manipal, India.
E-mail: naman.2398@gmail.com

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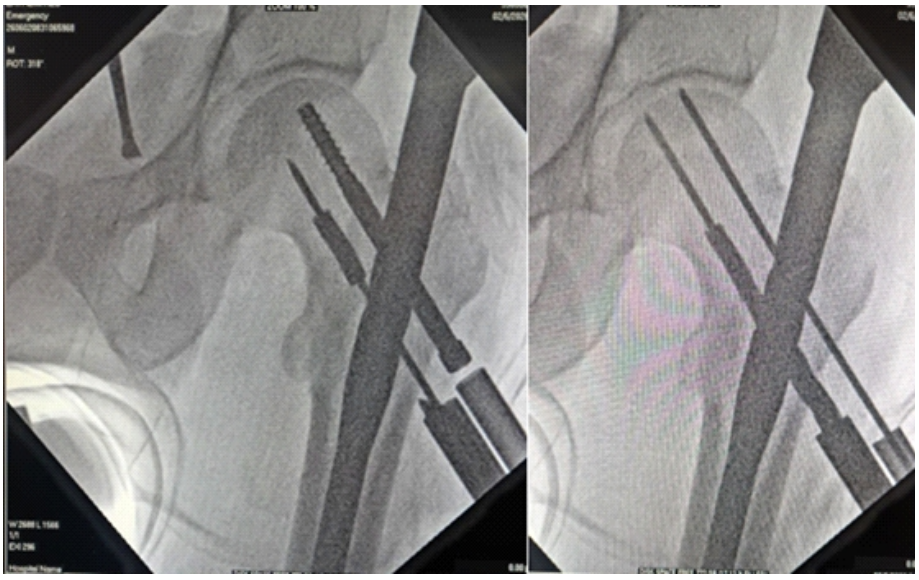


Figure 1: Fractured drill bit at mid-shaft, leaving the distal portion lodged within the reamed canal in the femoral neck. Intraoperative fluoroscopic image showing the fractured 8-mm cannulated drill bit with the distal fragment lodged within the femoral neck during proximal femoral nailing. The retained fragment lies along the compression-screw trajectory and necessitates retrieval to permit optimal implant positioning.

bits accounted for 11 of 14 total breakages over a 2-year surveillance period, and documented that patients were often not informed and documentation was frequently deficient [3]. Dharmshaktu et al. demonstrated that drill bits were the most frequently broken orthopaedic instruments in a retrospective study of elective procedures, with prolonged use and material fatigue identified as potential contributing factors [4].

Although the literature does not demonstrate significant long-term adverse effects from retained drill bit fragments, leaving them in situ carries tangible risks: Potential migration into adjacent structures, interference with planned implant placement, increased susceptibility to peri-implant infection, and medicolegal exposure [1,2,5]. Migration of broken drill bits has been documented in the context of acetabular fracture fixation and hip arthroplasty [5]. The femoral neck is a particularly challenging anatomical location for retrieval due to its limited access, restricted working space, and proximity to neurovascular structures. Suboptimal screw placement in proximal femoral nailing (PFN) – typically defined as a tip-apex distance (TAD) exceeding 25 mm or non-central screw position – is a well-established predictor of implant cut-out and fixation failure [6,7].

Several techniques for retrieving broken cannulated drill bits from the femoral neck have been previously described. Bassi et al. popularized a multi-K-wire technique in which a 1 mm K-wire with a right-angle bent tip is passed through the lumen of the broken drill bit to hook onto its far end, with two additional K-wires "stuffed" into the cannulation to facilitate traction [8]. Al-Kharouf et al. described using the hooked tip of a depth gauge, engaging the edge of the broken drill bit and employing clockwise and counterclockwise rotation to retrieve it through the proximal reaming tract [9]. Chouhan and Sharma reported a "push-back" technique using a narrow Langenbeck retractor, applicable where the broken fragment is longer than the bone diameter [10].

We describe a novel modification of the depth gauge technique – a lever method – that achieves more secure mechanical engagement of the broken fragment and facilitates safe, efficient retrieval without additional instruments, incisions, or significant extension of operative time.

Case Report

A male patient in his mid-sixties presented to our unit following a low-energy fall at home, sustaining a left intertrochanteric femur fracture. He had no significant comorbidities. After pre-operative optimization, he was taken to the theatre for closed



Figure 2: Engaging depth gauge with the broken drill bit. Intraoperative fluoroscopic images demonstrating advancement of the hooked depth gauge through the cannulation of the retained broken drill bit. The hooked tip is passed beyond the distal end of the fragment under fluoroscopic guidance and rotated axially so that its hooked tip was oriented to face medially and to facilitate mechanical engagement.

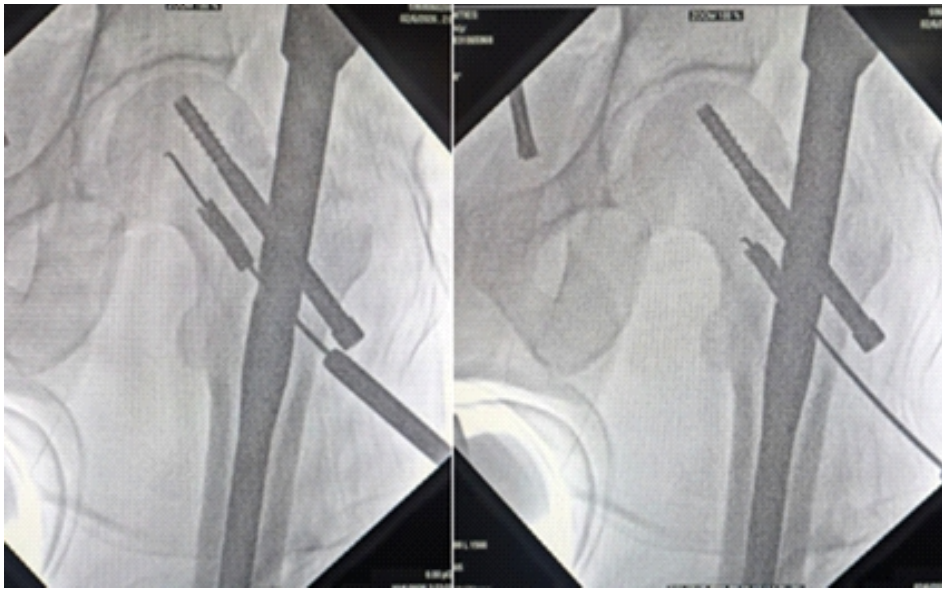


Figure 3: Performing the lever maneuver with depth gauge. Intraoperative fluoroscopic images demonstrating the depth-gauge lever maneuver used for retrieval of the broken drill-bit fragment. The hooked tip is engaged with the inner surface of the fragment, allowing controlled extraction through the proximal femoral nail.

reduction and internal fixation using a standard PFN.

The patient was positioned in hemilithotomy position on a fracture table. Closed reduction was achieved under fluoroscopic guidance. The intramedullary nail was inserted through a standard trochanteric entry point, and two guide wires were placed into the femoral neck and head using the targeting jig and biplanar fluoroscopic confirmation. During reaming over the inferior (compression) guide wire with an 8 mm cannulated drill bit, the drill bit fractured at mid-shaft, leaving the distal portion lodged within the reamed canal in the femoral neck (Fig. 1).

Retrieval of the broken fragment was necessary before proceeding, as its position directly obstructed placement of the compression screw at the desired TAD. Leaving it in situ would have necessitated a significantly suboptimal screw trajectory, increasing the risk of fixation failure.

Surgical technique

The proximal segment of the fractured drill bit, still attached to the drill chuck, was removed, followed by careful withdrawal of the guide wire through the cannulation of the broken fragment. A standard depth gauge from the PFN instrumentation set, which features a small hook at its distal tip, was then selected.

Under continuous fluoroscopic guidance, the depth gauge was carefully advanced through the reamed canal and through the cannulation of the broken drill bit until its hooked tip emerged from the far (medial) end (Fig. 2). The depth gauge was then rotated axially so that its hooked tip was oriented to face medially.

The key technical step – the lever maneuver – was then performed: While maintaining the hooked tip in its medial orientation, the proximal (external) arm of the depth gauge was levered firmly in the lateral direction, away from the limb (Fig. 3). This created a lever-arm effect that drove the hooked distal tip against the medial wall of the broken drill bit, establishing firm mechanical engagement with the inner surface of the fragment.

Fluoroscopic confirmation of hook engagement was obtained before applying steady, axial traction along the instrument axis. The broken 8 mm cannulated drill bit was retrieved in its entirety through the nail locking hole without any additional soft tissue dissection or cortical disruption (Fig. 4).

The guide wire was reinserted over the original trajectory, the canal was reamed with a new 8 mm cannulated drill bit, and the compression screw was placed in the optimal central-inferior position with a TAD of <25 mm (Fig. 5). The remainder of the procedure was uneventful.

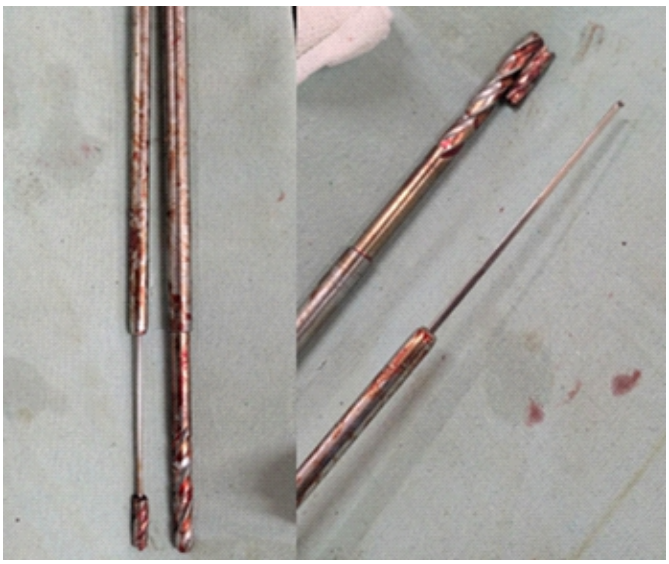


Figure 4: Intraoperative picture of broken drill bit post-retrieval. Intraoperative photograph demonstrating the retrieved broken 8-mm cannulated drill bit alongside the depth gauge used for its extraction. The intact cannulated drill bit is shown for comparison.

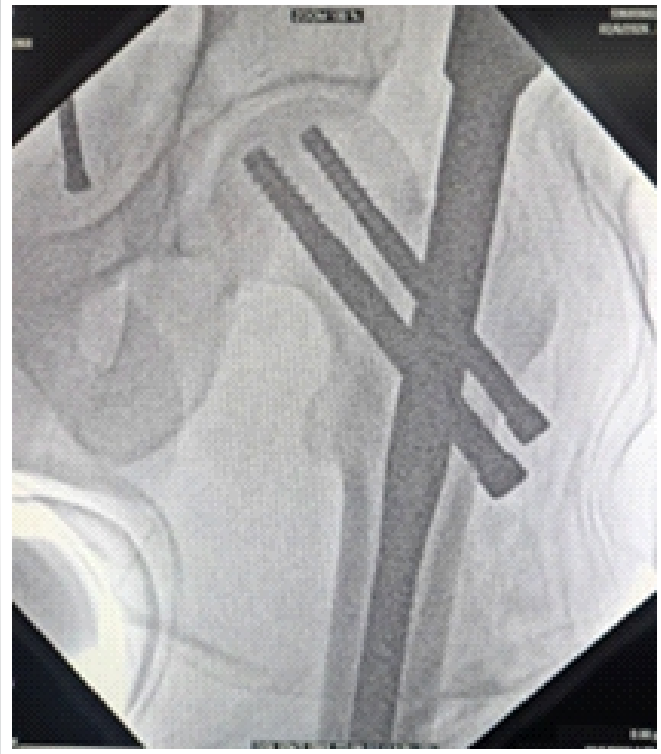


Figure 5: Final intraoperative C-arm image of completed procedure post-retrieval. Intraoperative fluoroscopic image following retrieval of the broken drill bit, demonstrating restoration of the compression-screw trajectory and satisfactory positioning of the proximal femoral nail and cephalon-cervical screws.

Discussion

Drill bit breakage during surgery is more common than the published literature suggests, as it is frequently underreported. Price et al. found documentation deficiencies in a significant proportion of cases and noted that patients were often not informed of the incident [3]. Real-world incidences are therefore likely to exceed published figures. Drill bits are the most frequently broken instrument in orthopaedic surgery, with repeated reuse across multiple procedures a key contributing factor, as material fatigue from cyclic loading significantly reduces the number of cycles to failure [3,4,8].

While no significant long-term adverse effects have been demonstrated from retained drill bits in well-embedded positions, the situation is markedly different when the fragment obstructs planned implant placement. In PFN, suboptimal compression screw positioning – particularly placement outside the central or inferior quadrant of the femoral head or with a TAD exceeding 25 mm – is strongly associated with screw cut-out, a potentially catastrophic complication especially in elderly osteoporotic bone [6,7]. In such circumstances, retrieval is essential. Additional concerns include the potential for migration [5], peri-implant infection, and the medicolegal risks of a retained foreign body in the absence of a compelling clinical justification [8].

The technical challenge of retrieval from the femoral neck has led to multiple described techniques. Bassi et al.'s multi-K-wire technique is well-established for larger-bore cannulated drill bits but requires considerable fluoroscopic time and technical precision in loading multiple K-wires into the narrow cannulation [8]. Al-Kharouf et al.'s technique of hooking onto the edge of the broken bit using a depth gauge tip and applying twisting traction is simpler but relies on surface engagement, which may be insufficient for deeply embedded or tightly wedged fragments [9]. Chouhan and Sharma's push-back technique is limited by the requirement that the broken piece must exceed the diameter of the bone, making it inapplicable in many scenarios involving the femoral neck [10].

Our technique offers several advantages over these approaches. First, by passing the depth gauge tip through the entire length of the broken drill bit's cannulation and emerging at the far end, we achieve intraluminal engagement rather than relying on surface-edge hooking, thereby providing a secure hold. Secondly, the lever maneuver – orienting the hook medially and levering the external arm laterally – exploits a mechanical advantage that actively drives the hook against the inner wall of the fragment before traction is applied. This two-step process (engage then extract) reduces the risk of the hook disengaging mid-procedure. Thirdly, the entire technique is performed using instruments already present in the standard PFN nailing set, with no requirement for additional specialized equipment, no extension of the surgical incision, and no violation of cortical bone beyond what has already been reamed.

A prerequisite for this technique, shared with the Al-Kharouf depth gauge method, is that the drill bit must be cannulated – the central lumen through which the depth gauge tip is passed is essential. This technique is therefore not applicable to solid drill bits. The use of continuous biplanar fluoroscopy during the retrieval steps is also strongly recommended to confirm correct hook orientation, engagement, and to monitor fragment position during traction.

From a preventative standpoint, departments should consider implementing a policy for the retirement of drill bits after a specified number of uses or upon demonstrating macroscopic evidence of wear. Quality checks prior to each use and single-use drill bits for critical high-stress applications may reduce the incidence of intraoperative breakage. Any instance of instrument breakage should be documented fully in the operative notes and the patient informed as part of post-operative disclosure [1,3].

Conclusion

We describe a novel lever technique using a standard PFN-set depth gauge for the retrieval of a broken 8 mm cannulated drill

bit from the femoral neck. The technique achieves secure intraluminal engagement of the fragment through a mechanical lever mechanism, enabling safe and time-efficient extraction without additional incisions, specialized instrumentation, or cortical violation. Removal of the broken fragment in this context was essential to allow optimal compression screw placement and to reduce the risk of implant failure. We recommend this technique in comparable intraoperative scenarios and advocate surgeon familiarity with the full repertoire of described retrieval methods.

Clinical Message

Broken drill bits are a rare intraoperative complication in orthopaedic surgery, and their retrieval can be technically challenging, particularly when the fragment is deeply embedded within bone. This case highlights a simple and reproducible retrieval technique that allowed safe removal of the fragment while preserving bone stock and maintaining stable fracture fixation.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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Author's Contribution: RP performed the surgical procedure and supervised manuscript preparation. VB assisted in the procedure, collected the clinical data, and reviewed the literature. NM assisted in the procedure, contributed to data interpretation, and supervised manuscript preparation. AK critically reviewed the manuscript and reviewed the literature for important intellectual content. SGN contributed to the review and editing of the manuscript. All authors read and approved the final manuscript.

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