CASE REPORT

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Removal of a femoral intramedullary nail with impacted nail end cap using a broken screw extraction set: a case report and literature review

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We report the technique we used in extraction of a femoral intramedullary nail with impacted nail cap. The extraction was done using a damaged screw extraction device and a bone hook, with no additional bone or soft tissue damage. This technique has not been reported before in the literature. We also review the cases reported for difficult nail extractions due to impacted nail end caps.

Keywords: Impacted cap; nail cap; nail removal.

Intramedullary nail end caps are used to prevent bone and soft tissue from growing into the proximal intramedullary threads of the nail, and to allow for easier subsequent extraction. They also enable adjustment of nail length.[1]

We present a case in which a femoral nail end cap was impacted in the upper end of the nail, preventing application of the nail extraction device. The nail was removed using a broken screw removal set. We describe the technique used for removal and review the literature.

Case report

A thirty-year-old patient with a healed fracture of the proximal left femur that had been repaired with a Trigen (Smith & Nephew Inc. Memphis, Tennessee, USA) reconstruction nail two years previously requested that the nail be removed. In the operating theatre, the patient was placed in the supine position on a radiolucent table. The skin incision was made at the scar of the index nail insertion procedure, and the two proximal screws removed. The two distal screws were exposed but were left in situ until after removal of the nail end cap and application of the nail extractor to prevent nail rotation within the medullary canal. The hexagonal wrench used to unwind the nail end cap failed to remove it. The hexagonal bolt on top of the nail cap had become smooth, and the cap was impacted in the upper end of the nail (Fig. 1a).

A damaged screw extraction device (Fig. 1b) was attached to the threaded recess at the centre of the nail cap bolt, and while it had good purchase on the nail end cap, it failed to unscrew it (Fig. 1c). The distal locking screws were removed, and vise-grip pliers applied to the damaged screw extraction device. The nail, with cap attached, was extracted from the medullary canal by upward tapping on the pliers. After retrieval of the proximal four centimetres of the nail from the medullary canal, the

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damaged screw extraction device broke. A bone hook was engaged through one of the proximal locking screw holes, which by the time the damaged screw extraction device gave way were out of the femoral medullary canal (Fig. 1d). Nail extraction continued by reapplying the vise-grip pliers to the bone hook and tapping it upward. When the upper end of the nail came out of the surgical wound, the vise-grip was applied directly to the upper end of the nail, and it was extracted by rotatory movement and gentle upward tapping. The wound was irrigated and closed without drainage. The post-operative period was uneventful. The patient was discharged home the following day, fully weight-bearing. He was seen in the outpatient clinic two weeks later for stitch removal. The wound was soundly healed with no infection, and the patient resumed work. He was seen again six months after surgery. He reported no symptoms and had a full range of left hip and knee movement with full motor power. He was contacted by telephone one year after the nail removal and described himself as perfectly normal.

Discussion

In patients with asymptomatic nails in the lower extremities, the indication for hardware removal is relative. For these elective procedures, good preoperative planning of the surgery is mandatory to prevent complications and medico-legal problems.[2] Communication with the patient is extremely important and should include discussion of the advantages and drawbacks, as well as a detailed explanation of the surgical plan. The consent form should also include the possible outcomes, including failure of removal and refracture.

Nail end caps were introduced to facilitate subsequent nail removal and for final adjustment of nail length. However, in our patient the cap hindered nail extraction. In a patient presented by Freeman and Atkins, the nail end cap was an obstacle to removal of a humeral nail.[1] The reason for their difficulty was removal of all the locking screws prior to extraction of the nail end cap to avoid fracture at the locking screw sites. This led to the entire nail revolving while trying to unscrew the cap. In a similar situation, removal of the locking screws followed by introduction of Stienman's pin in the locking screw holes would allow manual control on nail rotation without putting much stress on the osteoporotic bone. In our patient, the distal screws were not removed to avoid nail rotation while trying to remove the nail cap. This is common practice, but should be done with great care, as iatrogenic fractures would cause many more problems than would leaving the implant in place.

In our patient, the nail cap was impacted in the upper end of the nail and its hexagonal bolt had become smooth. We think this would happen if the threads of

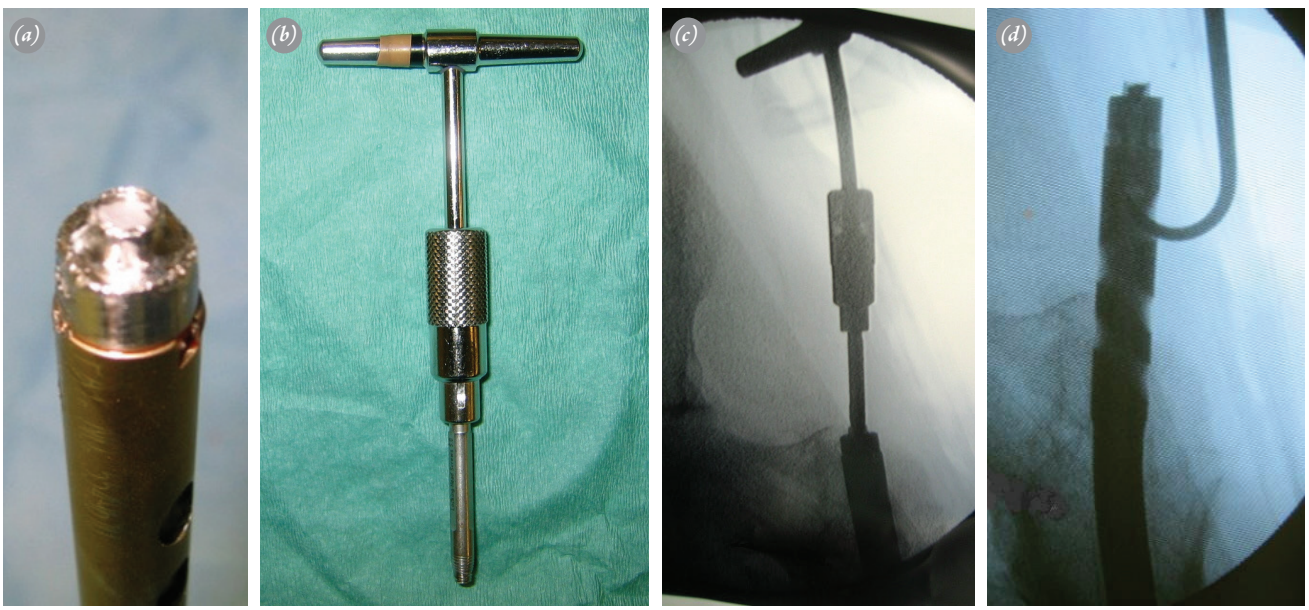

Fig. 1. **(a)** Upper part of an intramedullary nail with the irremovable nail cap. The outer surfaces of the hexagonal bolt on top of the nail cap as well as the threads at its central recess had become smooth. Notice the scratches caused by the vise-grip during nail extraction. **(b)** Damaged screw extractor used for extraction of a nail with impacted nail cap. **(c)** Intraoperative fluoroscopy image of broken screw extraction device attached to the nail cap central recess. **(d)** Intraoperative fluoroscopy image of the bone hook introduced through the hole of the nail's proximal locking screw to continue its extraction after breakage of the screw extraction device. [Color figures can be viewed in the online issue, which is available at www.aott.org.tr]

the nail cap were not perfectly aligned with the threads at the upper end of the nail at the time of insertion. In the case presented by Freeman and Atkins, the nail cap was prominent and could be grasped directly and extracted with the nail.[1] However, in our patient the nail cap was hidden within the medullary canal, and we avoided bone or soft tissue destruction by using the technique described. In a case where the damaged screw extraction device breaks before the nail is retrieved from the medullary canal, the nail would be removed by a push-out technique using a small diameter nail introduced retrogradely from the knee,[3] or through a working channel made in the lateral femoral condyle.[4] Alternatively, it could be removed through a wider skin incision to create a bone window at the greater trochanter. A bone hook would be introduced through the bone window to the proximal locking screw holes and used for nail extraction. All these alternative techniques entail extensive soft tissue and bone destruction, the latter of which necessitates restriction of weight-bearing until bone healing. Leaving the nail in place would be a wise decision in a case in which surgical trauma outweighs any expected benefit.

Yang had a difficult tibial nail extraction due to breakage of a hexagonal screwdriver tip in the nail cap recess, preventing removal of the cap. Removal of the broken screwdriver tip using a magnet was followed by an uneventful cap and nail extraction.[5]

A broken screw removal set was used by Ferry and Dahners for extraction of flexible intramedullary nails.[6] However, to the best of our knowledge, use of a broken screw extraction set for removal of an intramedullary nail with a locked nail cap has not been reported before.

Because of the difficulty encountered in this case, we limit the use of nail caps for final adjustment of nail length, as we think they are of no real benefit in facilitating nail extraction.

Intramedullary nail extraction is a challenging procedure.[2] To cope with difficulties, the surgeon should keep at hand a universal nail extraction device with conical extraction rods, universal screw extraction devices, universal emergency screw extraction devices, sharp hooks, bone rongeurs, bone curettes and osteotomes, ready to use in the procedure.

To conclude, nail end caps might be a hindrance to nail extraction. Using a broken screw extraction device and a bone hook allowed removal of the nail, together with the impacted nail cap. It is advisable to use end caps only if final adjustment of nail length is needed. Perfect alignment of the threads at the upper end of the nail and those of the nail cap allows for smooth insertion and facilitates possible subsequent extraction.

Conflicts of Interest: No conflicts declared.

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