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Case Report

Technical note on the removal of a "cold-welded" lag screw from a Trigen Meta-Tan nail☆

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ABSTRACT

Intramedullary or cephalomedullary nail removal often is performed during nonunion reoperations. We have experienced a rare case in which it was difficult to remove the lag screw of the antegrade intramedullary nail, requiring a large amount of force to be applied over a long period. Removal of the lag screw is essential for removal of the nail and subsequent revision surgery. In our case, the lag screw could be removed only by cutting the screw with a carbide drill. For cases in which the nail and lag screw are firmly fixed, surgeons should prepare for the possibility of their separation using a carbide drill. Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Introduction

Intramedullary or cephalomedullary nail removal often is performed during nonunion reoperations. Atypical femoral fractures have a higher nonunion rate than do other femoral fractures, and reoperation is common [1].

Reports have been made of problems with the removal of intramedullary nails, such as distal broken screws and nails [2,3]. Few reports exist for cases in which it is difficult to remove the lag screw of the intramedullary nail [4,5].

We have experienced such a case. Reoperation was difficult because the presence of a non-removable proximal lag screw from the femoral head and neck fragments prevented the removal of the intramedullary nail. Here we report our technique for overcoming this interference during removal surgery of a Trigen Meta-Tan nail (Smith & Nephew, Memphis, TN, USA) for a patient with an atypical femoral fracture.

Case presentation and operative techniques

A 73-year-old woman with no significant trauma history presented with a complaint of being unable to walk and deformation of the left thigh. As such, the patient arrived at our hospital by ambulance The X-ray findings at the time of injury were a left sub-trochanteric femur fracture and a thickened lateral cortex around the fracture (Fig. 1). Using the American Society of Bone and Mineral Research diagnostic criteria, the diagnosis was an atypical femoral fracture. This patient had been aware of left thigh pain since about 1 month before the fracture. X-rays also showed thickening of the lateral cortex sub-trochanter of the right femur (Fig. 2).

☆ This work has not been previously presented.

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Fig. 1. AP and lateral X-ray of the left femur.

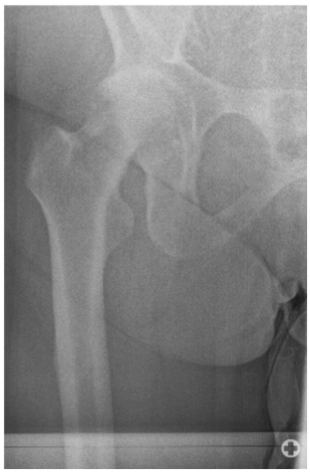

Fig. 2. AP X-ray of the pelvis and proximal femur.

The patient, who had comorbidities such as lupus and rheumatoid arthritis and had been taking bisphosphonates 11 years before the injury, underwent closed reduction and internal fixation with a Trigen Meta-Tan nail (Φ9.0 mm–300 mm, Smith & Nephew, Memphis, TN, USA) 2 days after the injury (Fig. 3). The operation time was 216 min, and the blood loss was 180 ml. The reason for not selecting a cephalomedullary nail (e.g., Smith & Nephew Intartan) was that the femur cortex was thickened, predicting that her intramedullary space would be narrow and thus difficult to insert this type of nail.

Weight bearing was not allowed for 4 weeks post-operatively, after which the patient was allowed to progress to full weight bearing. Low-intensity pulsed ultrasound was applied after the surgery, and then teriparatide was administered subcutaneously in the abdomen (20 μg once daily). Although we observed protracted fracture healing, the patient was older than age 70 years and had a strong desire to avoid reoperation. After healing, the patient was followed up at an outpatient clinic without surgical intervention. Varus deformity of the proximal bone fragment gradually progressed.

At 1 year and 7 months after the first operation, loosening around the lag screw appeared at the femoral head and neck (Fig. 4). We judged a high risk of complications, such as implant breakage or bone cutout, and performed reoperation at this time.

The patient was placed in the supine position on the traction table. First, we removed the distal locking screws. One screw of these

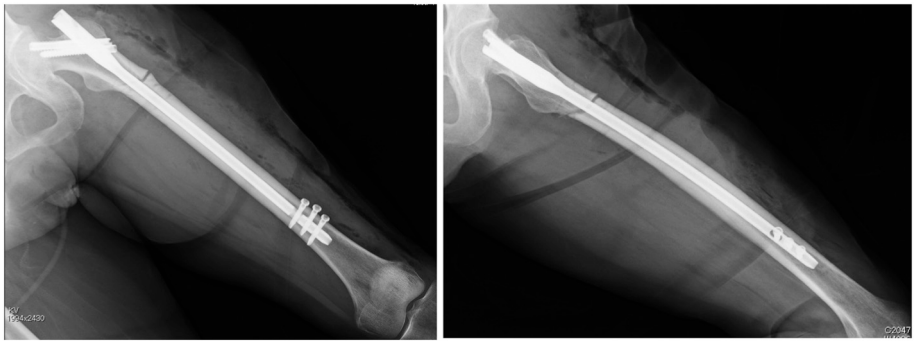

Fig. 3. AP and lateral X-ray of the left femur just after the first operation.

Fig. 4. AP and lateral X-ray of the left femur just before the second operation.

three was broken at the head; we excavated the surrounding bone and removed the broken screw shaft using a trephine. Second, we began to remove the lag screw. We could remove the distal lag screw easily using a hexagonal driver. It was difficult to remove the proximal lag screw, even with a special screwdriver.

The set screw of the lag screw had not been inserted in the first operation. It was difficult to remove even if the bone around the screw was cut from the outside toward the cervical head and neck using K-wire beyond the nail. The screw head was damaged and could not be removed by using screw extractors or vise grip–style pliers. We excised the outer cortical bone and cut the circumference of the nail around the lag screw insertion part using a carbide drill (Φ6.0 mm; DePuy Synthes, Paoli, PA) (Fig. 5). Still, we could not rotated or remove the screw. Finally, we cut the lag screw in the nail using a carbide drill (Φ6.0 mm) (Fig. 6). After cutting the lag screw, we removed the nail.

Then we removed the tip of the lag screw left on the bone fragment on the head side using forceps and implanted a 130-degree-angled TFNA (Φ10.0–340 mm, DePuy Synthes, Paoli, PA) using a standard technique. Because the outer wall of the trochanter was fractured, so we added fixation using a plate (LCP, DePuy Synthes, Paoli, PA) (Fig. 7). We used saline irrigation, suction, and forceps to remove the metal debris. The operation time was 376 min (270 min was needed to remove past implants), and the blood loss was 220

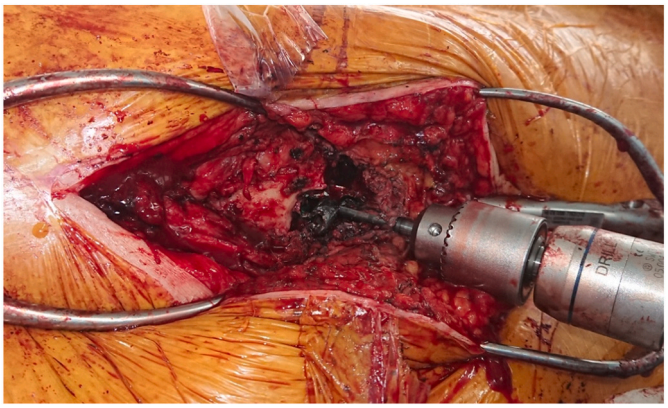

Fig. 5. Cutting the circumference of the nail around the lag screw insertion part using a carbide drill.

Fig. 6. Intraoperative view of her left proximal femur after the lag screw broken.

ml. Bone union after the second operation has not been obtained and is currently being followed up.

Discussion

Removing the φ8.6-mm proximal lag screw was difficult. It was possible to remove the φ6.2-mm distal lag screw without any problem using a hexagonal screwdriver. The proximal lag screw had a 32-mm thread at the tip, and the screw head was a combo type with a slotted core hollow driver. The Trigen Meta-Tan nail had a two-screws-type lag screw mechanism, and the distal lag screw head was hexagonal, but the proximal lag screw head was a characteristic combo type [6] (Fig. 8).

In this case, the cold-welding effect [7] was considered as why the removal resistance of the lag screw was very strong. It was observed that the loosening around the lag screw on an X-ray and computed tomography and considered the rotational resistance due to adhesion to the bone was not strong. This time, the set screw was not inserted in the nail, and the rotation resistance of the proximal lag screw should not occur on the contact surface with the nail. Because the inside of the nail was not threaded for a lag screw and had no fixing mechanism, rotational resistance could not occur on the contact surface with the nail. The screw was difficult to remove even with a trephine, an extractor, and vise grip–style pliers. In a situation in which the lateral-outer cortex was excavated and confirmed visually at the site of lag screw insertion to the nail, the contact surface with the lag screw and nail were in close contact. A varus occurs in a nonunion case, and during that time, we applied considerable varus force continuously to the lag screw, which was between the proximal lag screw and the contact bone surface. As a result of the continuous load due to the force against the internal reaction, it was possible to apply cold pressure welding.

Fig. 7. AP and lateral X-ray of the left femur just after the second operation.

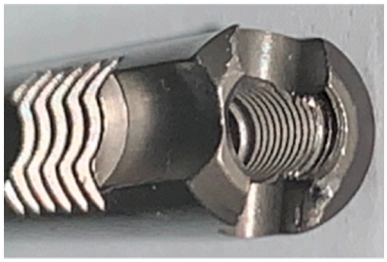

Fig. 8. Combo-type screw hole of a removal proximal lag screw (the another case).

When the plate and screw head adhere strongly to each other when the screw is fastened under an overload without using a torque limitation driver is called the "cold-welded" phenomenon [7]. The extraction screw may fail to engage the stripped screw or may break during attempted removal. A carbide drill can be used on the screw head until the plate disengages from the screw shaft [7].

Finally, we cut the lag screw with two carbide drills. The drill also broke at φ4 mm in the middle of the process, and by φ6 mm, the drill broke the outer surface of the nail and cut the lag screw. In cases in which it is necessary to remove the cephalomedullary nail or antegrade femoral nail by applying a large amount of force over a long period, As in this case, we may need to prepare for operation considering the possibility of cutting a screw with carbide drills [3,7].

Funding

None.

Ethical approval

Due to the retrospective nature of this study, ethical approval was not required.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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