CASE REPORT

Endoscopically controlled removal of a broken intramedullary nail
A new technique

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Introduction

Implant breakage is a well known complication of intramedullary nailing and many techniques are described to remove the distal part of a nail. A major disadvantage of all the techniques described is the requirement for an image intensifier in the OR. No technique under direct visual control has been described in the literature.

With the technique of IBE (intramedullary bone endoscopy) we would like to introduce a new endoscopic procedure for removal of a broken nail under direct visual control. The intraoperative use of an image intensifier is not necessary for this new procedure.

Case report

A 78-year-old woman sustained a closed inter-/subtrochanteric fracture of the left femur (AO Type 31-A-3.3) after a fall at home (Fig. 1). The fracture was treated with open reduction, cerclage wires and intramedullary nailing with an AO/ASIF-proximal femoral nail (PFN) (Fig. 2).

Twelve weeks after the operation the patient complained of a sudden onset of pain in the operated leg without a second trauma or fall. Radiographs showed breakage of the nail at the proximal interlocking hole (Fig. 3) and the patient was transferred to our clinic for further treatment.

At revision surgery, the proximal part of the nail and the interlocking screws were removed the usual way. Then the special prototype endoscope for IBE was inserted into the medullary canal from the nail entry point at the tip of the greater trochanter. The proximal end of the broken nail was identified and grasped with a forceps (Fig. 4). Simultaneously, a thin Hohmann retractor was placed into the hole were the distal interlocking screw was removed to push the nail upwards several mm and support the extraction with the forceps (Fig. 5).

After complete removal of the nail, the fracture site was reamed to stimulate bony healing and a long interlocking 360 mm PFN was inserted.
There are many descriptions of surgical techniques to remove a broken intramedullary nail in the literature. According to the type of the nail (hollow or solid) long hooks,\textsuperscript{4,6,8,17,22} multiple guidewires,\textsuperscript{1,13} cerclage wires,\textsuperscript{12} grasping devices,\textsuperscript{2,4} hand reamers,\textsuperscript{7,21} push-out-techniques\textsuperscript{9} or pull-out-techniques\textsuperscript{3,5,10,11,18–20} in antegrade or retrograde directions are recommended. However, endoscopic controlled removal of a broken intramedullary nail is not mentioned in literature.

In cooperation with the company Wolf-Endoscopes (Knittlingen, Germany) a prototype endoscope was developed in 2002. After the first successful application of the IBE-technique in long bones\textsuperscript{14} the endoscope was modified. The actual version is 375 mm in overall length and has a 10 mm × 8 mm oval working canal. The shaft of the endoscope is 11 mm in diameter. It is covered by a sleeve which is 13 mm in diameter to create a thin circular space which allows intensive irrigation (Fig. 5 and 6). Suction is possible at the handset of the endoscope or with a special endoscopic suction tool. A long bipolar coagulation hook is available as well as several forceps. The reliability of the new technique and the special endoscopic tools to work accordingly has been proven already in the first clinical tests. The IBE can be used for cement

**Figure 1** X-ray of the fractured femur.

**Figure 2** Postoperative X-ray after open reduction and implantation of a PFN.
removal in revision hip arthroplasty, as a salvage procedure after intramedullary loos of a reamer or for coagulation under visual control in case of endosteal bleeding.16

During the procedure of IBE, local peak pressure rises up to 125 mmHg at the tip of the endoscope. The local pressure is not perpetuated distally. It is far below the high levels of pressure that can be found during reaming or stem implantation in THA. Therefore, local or systemic side effects (fat embolism, local bone necrosis) common to intramedullary reaming in fracture treatment are unlikely.15

The major advantage of the new technique is the direct visualisation of the object that has to be removed. Contrary to the other techniques mentioned above, neither the surgeon nor the patient is exposed to radiation with the image intensifier. A broken nail is identified and grasped under visual control. No fluoroscopy is needed to remove it from the femoral canal. In case of removal of a hollow nail, the IBE-technique could be used additionally to any other pull out or push out technique with hooks, guide wires or other tools mentioned in literature.
References