



Fracture of an expandable intramedullary nail. Surgical technique for nail removal

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Intramedullary nailing with expandable nails is one of the techniques available for the treatment of fractures of long bones. Concerns regarding bony union have been reported in medical literature, but no case of femoral nail breakage secondary to delayed union has been reported to date. We present a case of a broken expandable femoral nail secondary to delayed union, and we describe the technique used for its extraction.

Keywords: femur ; diaphyseal fracture ; expandable nail ; nonunion ; nail breakage.

INTRODUCTION

Intramedullary nailing is currently the preferred treatment method for diaphyseal fractures of the femur. Inflatable nails have been reported to be as efficient as conventional intramedullary nails (2,3,5, 11,14,17). However, the use of inflatable nails has some drawbacks such as the occurrence of iatrogenic fractures during nail inflation, the inability of the nails to deflate during extraction after union and the lack of a possible dynamisation which may be required for delayed union (2). In cases with delayed union, the bending forces and axial load on the nail will not decrease, and this may lead to implant failure after a certain time period.

Failure of expandable nails has been reported in literature. In those cases, the expandable nail had deflated (12) and nail extraction could therefore be performed. We present a case of a broken

intramedullary expandable nail and describe our surgical technique for its extraction. The nail breakage occurred as a result of delayed union, resulting in leakage of the saline used to inflate the nail, but the longitudinal bars of the nail distal part of the nail failed to close.

CASE HISTORY

A 66-year-old male patient was operated in another hospital for a 2-part diaphyseal fracture of the femur (AO/OTA type 2) caused by a crush injury. He was admitted in our institution 6 months after the index operation with pain in his thigh, swelling, and inability to bear weight. Radiographs showed nonunion of the femur fracture, which had been fixed with an expandable intramedullary nail

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Fig. 1. — The broken nail and delayed union in the femur
a : AP view, b : Lateral view.

and cables (fig 1a-1b); the nail was found to be broken at the original fracture site, with the bars of the nail still open in the distal fragment. The former surgeon explained that cables had been placed on the proximal and distal fracture fragments as a preventive measure against iatrogenic development of a fracture during nail expansion.

The decision was made to reoperate on the patient. Intraoperatively, a swab was obtained from the nonunion site in order to rule out infection. The broken implant was extracted by an open surgical procedure; the surgical technique used is described below. After cleaning the fracture edges, a Trigen IM nail (13 × 400 mm) was inserted in a standard anterograde fashion after reaming, and was locked. The fracture site was grafted with iliac autograft bone. After surgery, the patient was mobilized without weightbearing for one month, partial weightbearing after the 1st month, and full weightbearing at the end of the 2nd month. Bony union was achieved after 8 months (fig 2a-2b).

Nail removal technique

A lateral longitudinal skin incision was made along the nonunion site. The cables on the proximal



Fig. 2. — Postoperative findings a : AP view, b : Lateral view

and distal fragments were removed. The proximal part of the broken nail was removed using the original implant removal instruments from the original proximal entry site in the proximal part of the greater trochanter. The distal part of the nail was firmly fixed to the distal fragment of the femur through its longitudinal bars. All attempts to extract the distal part of the nail with curved jaw locking pliers failed. A femoral channel reamer from the Trigen IM Nail System (Smith & Nephew, 14 mm in diameter, Channel reamer code : 7163-1118) (fig 3) was used to ream the distal femoral fragment around the proximal part of the broken nail. The internal diameter of the reamer was larger than that of the broken part of the nail at the fracture site but smaller than the diameter of the distal expanded portion of the nail. Using this technique, we could compress the bars of the nail into the channel reamer and release the nail from the bone. Using long-nose pliers and curved jaw locking pliers, the distal part of the nail was removed inch by inch. Using this method, it was possible to extract the nail without the need for an osteotomy.



Fig. 3. — Femoral Channel Reamer (Trigen IM Nail System 14-mm Channel Reamer-code : 7163-1118, Smith & Nephew, USA).

DISCUSSION

In the case reported, the expandable intramedullary nail was found to be broken owing to non-union, six months after it was implanted in another institution. During the index operation, open reduction was performed and two cables were fixed proximal and distal to the fracture. Intraoperative fractures have indeed been reported after nail expansion (13), which has encouraged some surgeons to perform prophylactic wiring or cable reinforcement. This is better avoided however, as it may compromise the blood supply and interfere with fracture healing.

The union rates of long bone fractures treated with expandable nails vary between 75% and 100% in literature (2,3,5,11,14,17). Following intramedullary nailing of a diaphyseal fracture, particularly in the lower limb, dynamisation of locking nails, grafting, or re-nailing after reaming are usually considered when there is evidence of delayed union 2 or 3 months after the index operation (7,9,19). In the case reported here, there was evidence of delayed union 3 months after initial nailing, but no further treatment was suggested. Expandable nails cannot be dynamized in these situations, and this is a disadvantage as compared with conventional nails. On the other hand, an intramedullary expandable nail should be strong enough to sustain mechanical stress until fracture union is achieved. The average time to union has ranged from 10 to 24 weeks in cases treated with expandable femoral nails (2,3,5,11,14,17). In the case reported here, the nail broke toward the end of this period ; breakage occurred at the original fracture site. It has also been reported

that an inflatable nail may be damaged during insertion or while performing open reduction (13). Failure of the nail flanges to close after breakage raises the question of possible damage during nail insertion. Another possible explanation for non-closed bars is the filling of the large contact surface of the nail created via its flanges (bars) and filling of the flanges with bone tissue (13). The diameter of the nail before inflation must be at least 2 mm less than that of the femoral isthmus (4,18) in order to provide the nail with rotational stability while inflating it to fill the isthmus. If the deflated nail fits exactly in the isthmus, then the proximal and distal parts of the nail will inflate but the isthmus part will not inflate or will partially inflate. In other words, the nail will take the shape of a sandglass. There is inadequate information, even from the manufacturer, on whether this will affect the mechanical properties of the nail.

We were able to extract the proximal part of the nail with standard instruments, but it was impossible to use the same technique for the distal broken part. Therefore, we were compelled to perform open surgery. The aforementioned surgical technique was used, because the part of the broken nail outside the bone was not long enough to be grasped and pulled with pliers, and also in order to avoid the anticipated morbidity related to a femoral osteotomy. Firstly, the channel reamer helped in the closure of the nail flanges, and secondly, it helped in creating a space to allow grasping the broken part with locked pliers. In all reports on the techniques for the removal of broken locking intramedullary nail parts, the broken part was either outside the bone (8,16) or the nail had a guiding hole that allowed grasping the broken part with a wire or screw (3,13). With solid or expandable nails, the extraction procedure is much more difficult, especially when the broken part is hidden within the bone (15). Using our technique, the broken part of the nail was removed in a fairly atraumatic manner. The channel reamer and the locking pliers are tools that are easily available.

To date, there have been no reports of breakage of expandable femoral nails. In our case, the expandable nail broke 6 months postoperatively due to nonunion. The broken parts of the nail were

removed using a relatively atraumatic technique ; the fracture was finally fixed with a reamed and locked titanium intramedullary nail and auto-grafted.

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