ABSTRACT

We report a complication of radiopaque wire breakage from the medullary tube during closed antegrade intramedullary nailing for a femoral shaft fracture. To avoid such complication, the medullary tube should be checked carefully for colour changes and surface defects, and tested for flexibility before each use. The medullary tube should also be replaced before 100 exposures to autoclaving.

Key words: femur; fracture fixation, intramedullary; fractures, bone

INTRODUCTION

Interlocking intramedullary nailing is commonly used for fixation of femoral shaft fractures.1 Breakage of the medullary tube has been reported,2–4 but breakage of the radiopaque wire from the medullary tube has not been reported. This complication is avoidable if precautions are taken.

CASE REPORT

In June 2009, a 50-year-old woman underwent closed antegrade intramedullary nailing for a closed fracture of the right mid-femoral shaft after a twisting injury on level ground. After general anaesthesia, the patient was positioned supine on the fracture table. Closed reduction was achieved under the image intensifier. After entry of a curved awl at the piriformis fossa, a ball-tipped reaming guide wire with a small bend at the end was used to assist the passage of guide wire across the fracture site. A flexible reamer was passed along the ball-tipped reaming guide wire, and the intramedullary canal was reamed to size 12.5 mm. A re-used Synthes medullary tube was then passed along the ball-tipped reaming guide wire for exchanging with a straight nail guide wire. There was some difficulty while the ball-tipped guide wire was being pulled out from the medullary canal. Because of the suspected blockage of the curved end of the
ball-tipped guide wire at the tip of the medullary tube, the medullary tube was pulled out from the medullary canal while the ball-tipped reaming guide wire was kept inside the medullary canal to maintain the fracture reduction. Another straight nail guide wire was then passed in parallel to the reaming guide wire, after which the ball-tipped guide wire was removed. An 11-mm AO antegrade intramedullary femoral nail was then inserted along the nail guide wire, and the nail was locked proximally and distally. During the final fluoroscopy, a radiopaque line was found in the distal femur (Fig. 1). It was a broken radiopaque wire from the medullary tube (Fig. 2). The broken wire was left in situ rather than opening the distal femur to remove the wire directly. After 3 months, the fracture healed without complications. At the 2-year follow-up, the retained radiopaque wire remained in the same position.

**DISCUSSION**

The medullary tube maintains fracture reduction while the bent ball-tipped reaming guide wire is being exchanged for the straight nail guide wire in the reamed medullary canal. Breakage of the medullary tube has been reported during closed intramedullary nailing, and could potentially increase surgical morbidity. In 2 patients, the closed nailing was converted to open nailing so as to retrieve the broken medullary tube. One patient had persistent postoperative pain and underwent another surgery for removal.

The appearance and mechanical properties of the medullary tube change over time. When the medullary tube is new, it is white and flexible, which allows bending into a semicircle. With repeated autoclaving, the medullary tube becomes yellowish. Material analysis demonstrated increased brittleness and decreased strength with increased exposure of medullary tubes to autoclaving, most dramatically after 100 autoclave cycles. The medullary tube was broken by three-point bending pressure during removal of the bent ball tipped guide wire. The presence of surface flaws and degradation of the

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**Figure 1** A radiopaque line (circle) is noted in the distal femur during final fluoroscopy.

**Figure 2** (a) A new medullary tube with a metal marker at its tip, (b) an old medullary tube with the metal marker scratched off at its tip.
surface finish act as stress risers and nucleation points for crack propagation.\textsuperscript{5} When the bent ball-tipped reaming guide wire is forced through the opening of the medullary tube, cracks along the surface flaw of the medullary tube propagate along the direction of pull of the reaming guide wire. This breaks the radiopaque wire. If the reaming guide is pulled out with excessive force, the medullary tube may fragment into pieces (Fig. 3).

According to the manual for the Synthes medullary tube, surgeons should check its elasticity from time to time, as frequent sterilisation may make it brittle.\textsuperscript{6} Re-used medullary tubes should be checked carefully for colour changes and surface defects and tested for flexibility by bending it into a semi-circle before each use. The medullary tube should also be replaced before 100 exposures to autoclaving.\textsuperscript{5} Excessive acute bending should be avoided in the ball-tipped reaming guide wire, and its smooth passage through the medullary tube should be checked before it is placed into medullary canal. If an acute bend is necessary to cross the fracture site or whenever difficulty is felt in retrieving the ball-tipped reaming guide, the medullary tube should not be used to exchange the guide wire. Instead, passage of a straight nail guide wire across the fracture site should be tried in parallel with the ball-tipped reaming guide wire, after which the ball-tipped reaming guide wire can be removed.

![Figure 3](image)

\textbf{Figure 3} When the bent ball-tipped reaming guide wire is forced through the opening of the medullary tube, it results in cracking along the surface flaw of the medullary tube. The cracks propagate along the direction of pull of the reaming guide wire, which leads to the breakage of the radiopaque wire from the medullary tube. If the reaming guide is pulled out with excessive force, the medullary tube may fragment into pieces.

In a new reaming system (such as SynReam by Synthes), the reaming rod enables smooth passage of the nail without the need of the medullary tube, and there are additional devices to help reduction, without using the bend ball-tipped reaming guide wire.

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