A patient with a history of total knee arthroplasty and 5 subsequent revisions presented with pain. His preoperative construct consisted of a revision implant with porous ingrowth stem extensions. He was indicated for revision surgery for a painful implant with progressive arthrofibrosis. The surgery proceeded uneventfully until we were unable to loosen the proximal portion of the ingrown femoral stem. After the distal femur was removed, a trephine was used to break the bone ingrowth from the distal portion of the stem. Flexible osteotomes were used to loosen the bone–prosthetic interface, but they were unable to penetrate deep enough, and they eventually bent under the applied loads. Nonflexible osteotomes were also used without success, and we were still unable to remove the stem from within the femur. Slap hammers, vice grips, and other devices were used to try to remove the stem, but attempts were unsuccessful. We hung a 3-liter bag of ice-cold (4°C) saline and ran all 3 liters of saline, under gravity pressure, retrograde down the femoral shaft in an attempt to contract the metal and allow for the removal of the stem. We then attached a stem extension screw to the incarcerated femoral stem and were able to remove it with minimal effort using a back-slap device. We inspected the prosthesis and found no abnormalities of the stem to explain its incarceration and no iatrogenic perforations in the femur. This case demonstrates a useful technique that should be kept in a revision surgeon’s armamentarium for the removal of incarcerated porous ingrowth stems.
Arthroplasty surgeons can encounter significant difficulty with the removal of previously implanted porous ingrowth stems. Beyond the use of trephines and flexible or rigid osteotomes, a new technique we have used to remove incarcerated stems is to lavage the implant with ice-cold saline in an attempt to contract the metal and allow for removal.

This article describes this novel technique, used after all standard methods of extraction failed. By lavaging the implant with cold saline, it was easily removed without damaging any of the surrounding bone. This technique is a good tool to have at a surgeon’s disposal when an incarcerated porous ingrowth stem is encountered.

CASE REPORT
A 65-year-old man with a history of a right total knee arthroplasty (TKA) and 5 subsequent revisions at an outside institution was referred to our institution reporting persistent pain and stiffness of the right knee. On physical examination, the patient was found to have a 30° flexion contracture and a total arc of motion of 60°. A workup for infection revealed a sterile aspiration with a cell count of 25 with 80% polymorphonucleocytes. Gram stain and aerobic and anaerobic cultures were negative. Gouty arthropathy was ruled out because the aspirate was negative for crystals.

The patient’s preoperative construct consisted of an IB-II 64+ tibial component with a 15×75-mm fluted stem and an IB-II Right CCK Femur with a 19×75-mm fluted stem (Zimmer, Warsaw, Indiana). Of note, the flutes on these implants are 0.4 mm larger than the core diameter of the stem, which has implications in terms of available tools needed for their removal. Radiographs demonstrated well-fixed components (Figure 1). The indication for surgery included a painful revision implant with progressive arthrofibrosis. Our surgical plan called for a complete revision of the current prosthesis and implantation of a hinged prosthesis. Surgery proceeded uneventfully until we were unable to fully loosen the proximal one-fourth of the sharp fluted femoral stem.

After the distal femur was removed by disengaging the distal taper and removing the locking screw, a trephine was used to break the bone ingrowth from the distal portion of the stem. We did not have a trephine large enough to fit around the size-19 stem, so flexible osteotomes were used to loosen the bone–prosthetic interface. The flexible osteotomes were unable to penetrate deep enough, and they eventually bent under the applied loads. Nonflexible osteotomes were also used, but they could not penetrate any farther due to the thin nature of the surrounding cortical bone and the creation of several nondisplaced distal supracondylar/intracondylar fractures. Using a combination of all of these tools, we were able to remove most of the distal surrounding ingrown bone; however, we were still unable to remove the stem from within the femur. Slap hammers, vice grips, and other devices were used to try to remove the stem, but attempts were unsuccessful.

Finally, we decided to use a technique previously performed by the senior au-
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Thor (F.R.D.) during the removal of incarcerated intramedullary nails. We hung a 3-liter bag of ice-cold (4°C) saline from an intravenous pole and attached it to sterile cystoscopy tubing. We then ran all 3 liters of saline, under gravity pressure, retrograde down the femoral shaft in an attempt to contract the metal and allow for the removal of the stem (Figure 2). We allowed the 3 liters to run over and around the prosthesis while we worked on removing the tibia.

Once the tibia had been removed without difficulty, we attached a stem extension screw to the incarcerated femoral stem and were able to remove it with minimal effort using a back-slap device around the screw itself. We inspected the prosthesis and found no abnormalities of the stem to explain its incarceration and no iatrogenic perforations in the femur. The remainder of the surgical procedure was uneventful; the patient did well postoperatively and was discharged to rehabilitation on postoperative day 4 in stable condition.

This intraoperative technique proved highly effective in the removal of these incarcerated stems. While it is unclear whether the type of ingrowth surface affected the usefulness of the cold saline lavage, this technique should be kept in a revision surgeon's armamentarium for the removal of incarcerated porous ingrowth stems.

DISCUSSION

In his report on revision knee arthroplasty, Berry\(^1\) stated that removal of well-fixed stems can be challenging. Cementless implants with or without bone ingrowth surfaces can have design features, such as splines or flutes, that can complicate their removal. Mason and Fehring\(^2\) reported the need for surgeons to be prepared with a variety of equipment, including saws, osteotomes, extraction devices, and ultrasonic devices, to remove well-fixed cementless or cemented implants. Removal of cementless stems may also necessitate the use of specially designed trephines to disrupt fixation at the bone–implant interface. Berry\(^3\) reported the need for thin, high-speed cutting tools or burrs, as well as trephines, originally designed for the removal of well-fixed cementless hip stems, to cut the stem free from bone. Others, in the context of removing femoral components during revision hip arthroplasty, have advocated the creation of a distal cortical window to access the bone–implant substrate interface.\(^4,5\) Each of these methods may be associated with a significant risk of bone loss or fracture and can be difficult to implement in cases where poor quality bone is present.

The method described in this article can be added to the revision surgeon’s armamentarium when well-fixed, cementless stems are encountered. Lavaging a cementless metal stem augment with cold saline can be a valuable option before resorting to osteotomy or other techniques that may risk further bone compromise in an already difficult reconstructive situation.

REFERENCES