Smooth Pins Reinforcing Static Cement Spacers for Infected Total Knee Arthroplasty Are Not Safe

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Prosthetic joint infection is one of the most dreaded complications following elective lower extremity primary total joint arthroplasty, resulting in substantial pain, disability, and health care costs. Both static and articulating antibiotic-impregnated spacers have been used in the management of 2-stage revision for infected total knee arthroplasty, which remains the gold standard for treatment of these infections. Articulating spacers may provide theoretical benefits with regard to improved range of motion after reimplantation secondary to less scar formations and soft tissue contractures. However, static spacers may be necessary to overcome instability associated with substantial bone defects, incompetent extensor mechanisms, and collateral ligament insufficiencies. In these scenarios, static spacers are often reinforced with intramedullary rods or Steinmann pins to provide additional knee stability, improve construct strength, maintain extension, and avoid flexion contractures. This case report describes an extremely rare case of migration of smooth pins through the posterior tibia into the calf following static spacer use in a 48-year-old man. Various mechanical and systemic complications have been reported in up to 50% of patients with the use of polymethyl methacrylate spacer devices, such as acute renal failure, allergic reactions from antibiotic use, stiffness, bone loss, fractures, and dislocations. However, to the best of the authors’ knowledge, this complication of hardware migration has not been reported previously in the literature. The authors believe that orthopedic surgeons should consider the use of threaded pin dowels or intramedullary rods to avoid this potential untoward complication. [Orthopedics. 2016; 39(3):e553-e557.]

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they preserve the joint spaces, maintain limb lengths for future reconstructions, are less costly, and may provide improved limb stability.\textsuperscript{8-10} Static spacers can be constructed of antibiotic cement alone or in the presence of substantial bone defects, or collateral ligament insufficiencies may be reinforced with adjuvant hardware, such as smooth or threaded Steinmann pins or intramedullary nails. Supplemental hardware used in these scenarios may improve construct strengths, provide inherent stability, prevent further bone losses, decrease subsidences, and reduce the chances of development of soft tissue complications, including flexion contractures, patellar dislocations, and patellar tendon ruptures.\textsuperscript{4,9-14} Although these spacers have been successful in eradicating infections, several complications are reported with their use, including dissemination of infection, bone loss, erosion of spacer blocks, joint stiffness from immobilization, migration of the spacer blocks, and quadriceps shortening, making surgical exposures during reimplantation technically demanding.\textsuperscript{4,12}

This case report describes the migration of Steinmann pins from modified antibiotic-loaded poly methylmethacrylate (PMMA) static spacers used for treatment of chronic periprosthetic knee infection in a 48-year-old man. Although pin migration from modified static spacers is a theoretical risk, to the best of the authors’ knowledge, these complications have not been previously reported.

### Case Report

A 48-year-old man with a past medical history of insulin-dependent diabetes mellitus and hypertension developed instability and chronic coagulase-negative \textit{Staphylococcus} periprosthetic left knee joint infection (Figure 1). He subsequently required multiple extensive irrigation and debridement procedures with placement of static antibiotic spacers due to persistence of infection (Table). Because of extensive bone loss, ligamentous insta-
bility and a large space, the static spacer was reinforced with 2 smooth Steinmann pins, 4.8 mm in diameter and 23 cm in length, traversing the knee joint during these procedures. The pins were inserted in the distal femur using a power drill, keeping half the length projecting from the distal femur. The pins were spaced from each other for stability. The proximal tibia was subsequently reduced to the projecting ends of the pins. Keeping the tibia reduced, the pins were inserted into the proximal tibia by gently tapping the pliers, which are used to grab the midportion of the pins. The space between the tibia and femur was maintained using a spacer block during insertion of the pins into the proximal tibia. Thus, one-third of the Steinmann pin length was inserted in the femur and tibia on each end, whereas one-third of the entire length was situated in the tibiofemoral space. The PMMA dough was then applied in the tibiofemoral space and around the pins and allowed to harden.

Postoperatively, after each procedure the patient was allowed 25% partial weight bearing in a knee immobilizer and received 6 weeks of intravenous antibiotics based on the organism and antibiotic sensitivities. Due to persistent elevation in inflammatory markers with an erythrocyte sedimentation rate of 50 and C-reactive protein of 20.1, a repeat irrigation and debridement was scheduled for a fifth time, 7 months after the initial explant (Figure 2).

In the preoperative holding area, the patient reported progressively increasing distal calf pain in the surgical limb that had developed over several days. On physical examination, he had focal induration and swelling in the posterior calf just medial to the Achilles tendon. Furthermore, the patient had significant tenderness to palpation of the calf with a positive Homan’s sign. A duplex ultrasound revealed edema without a cyst or solid mass within or adjacent to the Achilles tendon. No deep venous thrombus was visualized.

Intraoperatively, in addition to the induration in the posterior calf, the periprosthetic tissue appeared infected, although no gross purulence was noted (Figure 3A). Aggressive irrigation and debridement was performed, and the antibiotic cement spacer was systematically removed. At this time, it was noted that no Steinmann pins were visible in the joint space. One had migrated distally into the tibial canal, and the second could not be seen (Figure 3B). When a small defect was noted in the posterior tibial cortex, intraoperative radiographs were obtained. They revealed that the Steinmann pin had migrated into the posterior leg and was abutting the subcutaneous tissue medial to the Achilles tendon (Figures 4A-B). A longitudinal stab incision was made, and the pin was removed without difficulty (Figure 4C). Frozen sections demonstrated persistent infection, so a static spacer exchange was performed. A tibial intramedullary nail, with a wider diameter than a Steinmann pin, was used to provide stability for the spacer in this setting of extensive bone loss (Figure 5).

The patient did well postoperatively, with no significant neurological or vascular deficits. He received a prolonged course of intravenous antibiotics and immobilization in a long-leg cast to eradicate the infection.
Hardware migration has long been recognized as a potential complication of orthopedic implants, with over 100 cases reported in the literature. Various authors have described migration of orthopedic implants either immediately or, more commonly, many years postoperatively. Pins and wires have been known to dislodge within the spinal canal, pelvis, joints, mediastinum, innominate vein, lung, spleen, and heart. Numerous purported mechanisms have been described to explain the migratory behavior of these devices, including pin and wire sizes, smooth surface textures, broken or loose implants, osteolysis, poor bone qualities, prolonged implantation times, implant locations in shoulder and hip girdles, repetitive movements across the line of axial motion of joints, gravitational forces, capillary actions, respiratory excursions, muscular activities, and traumatic dislodgements.

The current case report presents a case of migrated smooth Steinmann pins associated with an antibiotic-loaded static spacer for the treatment of periprosthetic joint infection. The pins were used to reinforce the static spacer in the presence of large cavitary bony defects. The goal was also to bridge the joint space and provide additional immobilization, leading to improvements in construct stability. Steinmann pins were chosen because they are easier to cut and remove during subsequent revisions. In this patient, the pins migrated because they were smooth, smaller in diameter, sharp at the tips, and compounded by increased axial motion and joint instability. In addition, it was uncertain whether the patient was compliant to postoperative weight-bearing restrictions. The complication reported in this case could have had devastating outcomes if posterior neurovascular structures were compromised by the pin migration.

Static spacer construct stability decreases considerably when Steinmann pins do not have substantial purchase within cortical bone. Furthermore, pre-existing knee instability may lead to increased motion between the pin and cement, leading to delamination of the pins from the surrounding cement mantle. This may ultimately cause migration of the smooth pins. Moreover, unrestricted weight bearing in the presence of knee instability may further accentuate delamination between the pin and cement mantle and potentiate implant migration. Pin dislodgement and migration may be prevented by ensuring substantial purchase of the pins with the distal femur and proximal tibia; using large-diameter pins to increase construct stiffness, as well as threaded pin dowels; restricting weight bearing; and avoiding hyperextension to prevent delamination of pins from the surrounding cement mantle. These measures may potentially decrease the risks of these untoward complications. The authors still use adjuvant hardware to provide additional joint stability in
the presence of major bone loss and poor bone quality. Currently, they use threaded Steinmann pins with the ends cut instead of smooth pins. The threads allow for cement interdigitation, which may decrease pin-cement delamination and hardware migration, thereby potentially reducing the risks to local neurovascular structures. A wire cutter can ease removal of the pins during reimplantation. In the presence of severe bone loss and incompetent ligaments, intramedullary nails may provide better stability to the temporary fusion site. However, nail removal can be technically demanding, requiring specialized instruments and more extensive exposures.

**Conclusion**

Surgeons should be cognizant of the potential risks of hardware migration when fabricating static spacers for the treatment of periprosthetic joint infections. When dealing with cases of bone loss, poor bone quality, or knee instability, consideration should be given to using larger-diameter, blunt, threaded implants to decrease the risk for cortical perforation and subsequent migration.

**References**