Use of Titanium Mesh Cage in Treating a Subtrochanteric Defect: A Case Report

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ABSTRACT

Titanium mesh cages have been used during fixation of segmental defects in long bones; however, use in the subtrochanteric region of the proximal femur is a novel application. We describe a 38-year-old, 330-lb man with a highly comminuted fracture about the right femur after a gunshot wound. Immediate treatment involved use of a cement spacer. Findings of follow-up imaging showed about 26° external rotational deformity and 2-cm limb shortening. To correct the rotational abnormality and limb length discrepancy, a cylindrical titanium mesh cage and custom-made femur locking plate with a cancellous bone autograft were used. Subsequently, successful bridging was obtained across the defect. Titanium mesh cages may be potential alternative devices to use in treating segmental femoral bone defects in the subtrochanteric region of the femur.

Keywords: Hip Fracture, Revision Surgery, Surgical Mesh

INTRODUCTION

Several treatment options exist for posttraumatic segmental defects in long bones, including vascularized bone grafts, the Masquelet technique, and distraction osteogenesis.[1-8] Cylindrical mesh cages packed with a cancellous bone allograft or autograft were first reported by Cobos et al[9] in 2000. Multiple studies on cages have reported improved incorporation of the graft into the defect, shorter times to limb function recovery, and fewer additional procedures.[9-13] In 2006, a canine study reported histological findings that indicated significantly more healing in the femoral diaphysis group using cages than in the control group.[14] Use of cylindrical mesh cages in human long bones has mostly been reported in the humerus, tibia, and mid-femur.[9-13] To our knowledge, there are no reports of using the cages in the subtrochanteric femur, where biomechanical stresses exerted on the implant are especially high. We describe successful application of a cylindrical titanium mesh cage after a considerable subtrochanteric defect.

CASE REPORT

A 38-year-old, 330-lb man presented to the emergency department with multiple gunshot wounds to his left forearm, upper chest, abdomen, and right groin. The resulting injuries included a highly comminuted proximal fracture about the right femur with segmental bone loss (Figure 1), and a left-radius fracture with a grade IIIA Gustilo-Anderson classification.

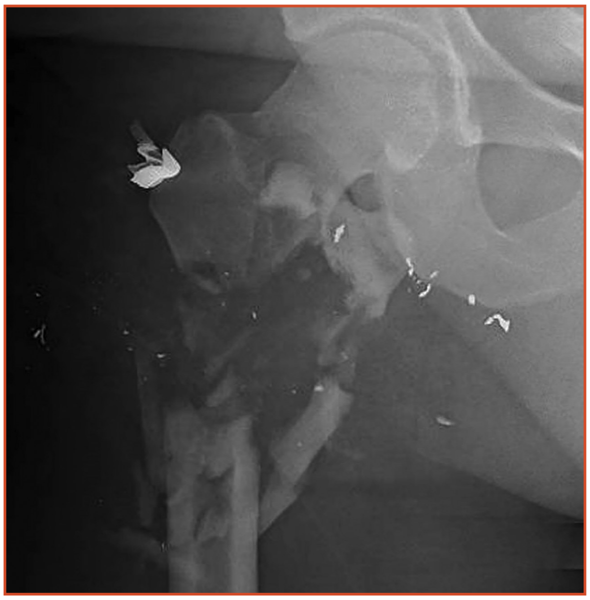

Figure 1. *Anteroposterior view of the right hip, obtained in the emergency department.*

After overnight resuscitation in the trauma intensive care unit, a fellowship-trained trauma orthopaedic surgeon (RG) performed open reduction and internal fixation (ORIF) using a custom-made locking plate for treating the right-proximal femur fracture. A lateral approach to the hip was used. Fully stripped bone fragments were removed, revealing 5 to 7 cm of bone loss. Owing to the extent of the injuries, a temporary antibiotic cement spacer was used to fill the defect (Figure 2). ORIF for treating the left radial shaft fracture

Figure 2. *Anteroposterior view of the right hip immediately after initial open reduction and internal fixation, with antibiotic spacer placement.*

was completed 5 days later. The patient was discharged 28 days after admission to an inpatient skilled nursing facility, with a touchdown weight-bearing restriction of his right leg.

His right femur was clinically noted to be short and externally rotated. At 11 weeks after injury, the results of a computed tomography scan confirmed these findings. More specifically, the right femur was 27° externally rotated and 2.4-cm short, relative to the left side. Deformity correction and definitive fixation were planned, including adjunct use of a titanium mesh cage to accommodate the size of the defect and the patient's weight of more than 330 lb. Although technically possible to perform within 4 to 12 weeks after placing a cement spacer, second-stage definitive fixation was delayed for our patient. This was decided so that the patient could spend 5 months in a dedicated rehabilitation facility to optimize his medical fitness and psychosocial readiness.

During the second-stage definitive fixation, a sterile goniometer and fully threaded Steinman pins were used to mark the rotational correction. The existing plate, screws, and cement spacer were all removed. The healing bone that was preventing deformity correction was excised. When the fracture site was adequately mobile, reamer irrigator aspirator was passed once to obtain about 30 cm^3 of autograft. A 68-mm cylindrical titanium mesh cage was packed with autograft and placed into the defect. A new custom-made proximal femur locking plate was secured, achieving both deformity correction and fixation (Figure 3). A touchdown weight-bearing restriction was again implemented. The patient was discharged to inpatient rehabilitation 6 days postoperatively.

At 6 weeks postoperatively, the patient was actively involved in a physical rehabilitation program and was

Figure 3. *Anteroposterior view of the right hip immediately after revision open reduction and internal fixation, with a titanium mesh cage and proximal femur locking plate.*

Figure 4. *At 3 months after revision open reduction and internal fixation, radiograph shows anteroposterior view of the right hip with a titanium mesh cage and proximal femur locking plate.*

advanced to weight bearing as tolerated. At 3 months postoperatively, the patient was primarily using a walker for ambulation but was able to bear full weight on his right-lower extremity without pain. He was able to flex and extend his right hip through a functional range of motion with complete strength. Radiographic imaging findings of the right femur revealed considerable interval healing and bridging bone with some heterotopic ossifications in the area (Figure 4).

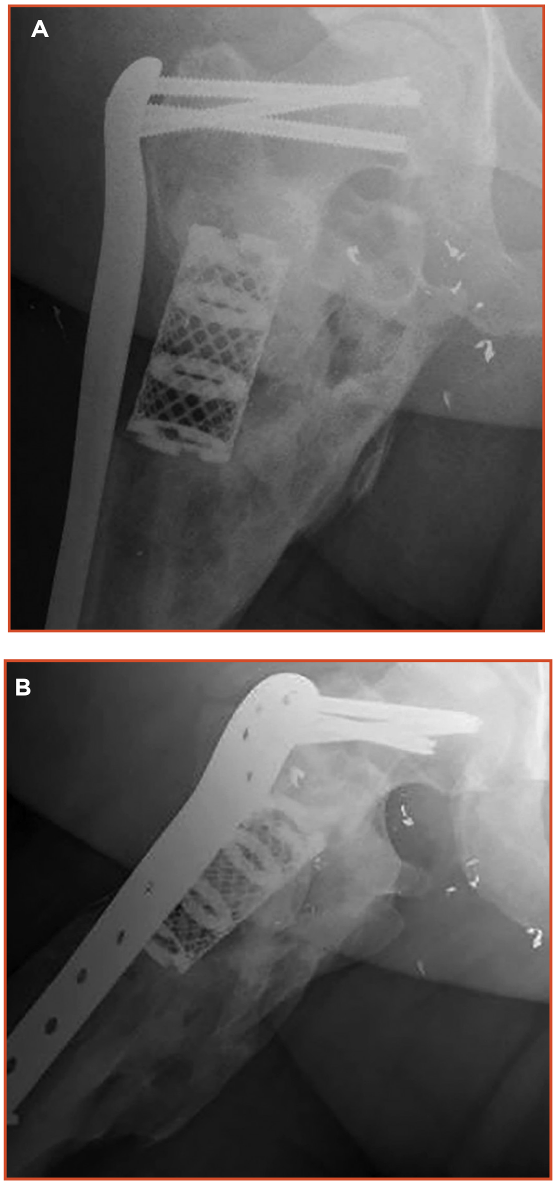

Figure 5. *At 15 months after revision open reduction and internal fixation, radiographs of the right hip show the titanium mesh cage and proximal femur locking plate. A) Anteroposterior view. B) Lateral view.*

During the last follow-up at 15 months postoperatively, the patient remained clinically functional with only mild pain reported at the hip with range of motion. On visual inspection of his alignment, the right- and left-lower extremities appeared symmetric. Findings of radiographs continued to show healed bone with interval increase in callus formation medially (Figures 5A and 5B). No hardware failure or loosening were noted despite the patient's weight gain of more than 100 lb since definitive surgical fixation.

DISCUSSION

Management of large segmental bone defects can be a challenging endeavor. Common treatment options include use of vascularized bone grafts, the Masquelet technique, and distraction osteogenesis. Each option is associated with complications.[1-8] Use of vascularized bone grafts for treating segmental bone defects was first described in 1975.[1] Although this option has a high consolidation rate, it involves a highly complex procedure that typically requires surgeons with specialized training to both harvest and transfer the graft.[2,3] Potential negative outcomes include fracture at the site of the graft, failure of fixation of the graft, and the need for reconstruction of the anastomoses due to poor limb perfusion.[2,3]

Masquelet et al[4] described filling a segmental defect with a cement spacer, inducing the formation of an overlying pseudosynovial membrane. After cement spacer removal, the encapsulating membrane is filled with a bone autograft. Although this technique can take several months to achieve the desired result, it has been shown to be successful in the humerus, tibia, and femur.[5,6] Wong et al[5] reported a mean interval of 43.5 days between placement of the spacer and the second surgical procedure to apply the autograft. Apard et al[6] reported decreasing the time required for complete weight bearing after the second stage by fixation using an intramedullary nail, but mean time was still 4 months.

Another option for treating large segmental defects is distraction osteogenesis, also known as bone transport, with an Ilizarov apparatus.[7,8] This involves slowly separating two distracted bones, during the course of months, as new bone forms in between the segments.[7] Bone transport is an effective method for reconstructing large bone defects; however, there are numerous potential complications such as implant site sepsis, instability at the docking site, and joint contractures.[8] Furthermore, time to healing is proportional to the size of the defects. Green[8] reported an average fixation time of 1.9 months per 1 cm of bone loss. Thus, a 6-cm defect might require almost 1 year to address using distraction osteogenesis, whereas using a titanium mesh cage could result in consolidated bone healing around 3 months.

Titanium mesh cages are an attractive alternative with an increasingly reliable track record after emerging in the early 2000s. Use of them has resulted in shorter time to unencumbered limb function[9-12] in comparison to the Masquelet technique and distraction osteogenesis. Cobos et al[9] initially reported 3 months of full weight bearing function after fixation of fibular defects; this timing is consistent with that of other case studies.[10-12] Additionally, the application is a straightforward procedure, employs the use of readily available implants, and provides immediate limb stability,[9-14] putting it at an advantage compared to the vascularized bone transplant. Compared to idiopathic membranous nephropathy, which is typically not used for management of critical bone defects, use of titanium mesh cages easily allows implantation of a larger quantity of contained bone graft. A theoretical disadvantage of the application of these cages includes risk of infection when treating an open fracture.[10,11] Although Reynder et al[13] reported promising bridging bone after application about the femur, no osseous continuity was found within the mesh cage. Owing to the practical advantages, titanium mesh cages should be considered as a viable method for the fixation of large segmental bone defects, even in high-stress areas such as the subtrochanteric femur.

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