Extended Osteotomy for Periprosthetic Femoral Fractures in Total Hip Arthroplasty

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Abstract
Total hip arthroplasty periprosthetic fractures that involve a loose prosthesis and are located at or beyond the tip of the prosthesis are difficult to manage and have higher complication and nonunion rates. In this case report, I describe a fracture-site exposure that allows simple insertion of a long, distally fixed revision prosthesis. In an extended femoral osteotomy, the entire proximal fragment opens the upper segment in “clamshell” fashion. The proximal segment is repaired with or without femoral strut allografts and multiple circlage wires. With this method, 7 periprosthetic fractures united successfully, and none has required further reconstruction.

METHODS
Of a series of 300 revision total hip arthroplasties performed between 1992 and 2002, 145 required revision of the femoral component. In this group, 7 periprosthetic fractures involved the femur distal to the tip of the stem of a loose prosthesis. According to the Vancouver classification scheme of Brady and colleagues,9 these fractures are B3 variants10 (Figure 1). All 7 patients were female. Mean age was 77.5 years (range, 67–87 years). In all 7 cases, the femoral component had been cemented (2 patients had undergone a cemented revision arthroplasty), the cemented implants were loose or had significant fibrous demarcation (no cases of solid fixation), and surgeries were performed only with revision of the femoral stem and repair of the periprosthetic fracture (no revision of the acetabular component). The acetabular components were well fixed, according to radiographic and clinical assessment at time of revision, and none of the cups of the fracture. The entire proximal segment, which consists of the bone and the prosthesis, is opened like a clamshell, allowing simple removal of the old implant and debris.

Figure 1. Vancouver B3 periprosthetic fracture in a 78-year-old woman.
had wear severe enough to warrant revision.

**Surgical Technique**

A lateral decubitus position was used in all cases, and the approach was an extended posterolateral incision. As acetabular revision was not performed in any case, exposure of the acetabulum was limited. The initial dissection continued distally along the linea aspera to reflect the vastus lateralis anteriorly and to access the fracture site. At this point, an oscillating saw was used to perform an extended osteotomy on the linea aspera along the entire proximal fragment. The osteotomy was extended through the cement mantle to the anterior cortex. The resulting bivalved proximal fragment was then split and opened like a clamshell. Dissection was done meticulously to preserve as much soft-tissue attachment to the fragments as possible. The cement mantle and the femoral stem were easily extracted from the split fragments (Figure 2). The tubular distal fragment was then exposed for preparation and prosthetic insertion.

In 5 cases, a fully porous, coated, chrome-cobalt 8-inch stem was used, and the fragment was underreamed by 0.5 cm—initially with a flexible reamer (to avoid eccentric reaming or perforation) and then with a straight reamer. In 2 cases, the dimensions of the fluted, tapered stem and the tapered reamer were precisely the same. In all 7 cases, an additional measure was taken—one or 2 cerclage braided cables were placed around the orifice of the distal fragment to prevent accidental splitting (Figure 2). Trialing was done to estimate the final position of the implant to ensure adequate length and hip stability (Figures 4, 5). For final insertion, the implant was driven...
to the desired position in the distal canal (Figure 6).

If the proximal fragments remained intact, they were assembled about the proximal prosthesis and were cerclage-wired into rigid position. In 4 cases, the remaining fragments of the proximal femur were so osteoporotic and tenuous that the strut allografts were used to reconstitute the bulk of bone about the proximal implant (Figure 7). To avoid stripping the soft tissues from these osteotomized fragments, the allografts were applied against the prosthesis, and the remaining femoral fragments were wired in place over the allografts. Careful sculpting of the grafts, using a motorized burr, was required. In 1 case, distal prosthetic fixation was achieved so far distally that the final length of the prosthesis in the femur left a 4-cm gap from the cup to the revised femoral ball. This problem was solved by buttonholing the femoral ball into the capsular soft tissue that remained about the cup. Heavy sutures then tightly secured the capsule scar tissue around the prosthetic femoral head and neck.

RESULTS

All osteotomies stabilized after non–weight-bearing for 6 to 12 weeks, and the implant fixation remained satisfactory on subsequent follow-up, which ranged from 2 to 6 years. Radiographs of allografts showed incorporation over an extended period, 6 to 12 months (Figures 8, 9). None of the 7 distally fixated femoral stems showed any measurable subsidence over the follow-up period, which was a minimum of 2 years.

DISCUSSION

Femoral periprosthetic fractures at the tip of the prosthesis or below the prosthesis and associated with implant loosening pose an extreme challenge for the reconstructive surgeon. Previous authors have reported high complication rates with persistent nonunion in up to 50% of such cases, particularly when traditional femoral plating methods are used. Recent anecdotal reports have suggested that distal intramedullary prosthetic fixation is a viable method for dealing with such fractures.

Of the 14 periprosthetic fractures treated by Macdonald and colleagues, 4 were Vancouver type B about a loose stem. In most of these cases, long porous stems of 8 or 10 inches were used with extended lateral femoral osteotomies. In all cases, fracture healing was satisfactory, and the stem achieved stability without loosening or subsidence. Ko and colleagues treated 12 Vancouver B2 periprosthetic fractures with distal fixation revision using the Wagner fluted, tapered titanium-alloy stem with grit-blasted surface. All cases had a stable implant with fracture healing at follow-up, but stem subsidence was apparent in 2 cases. Kwong
and colleagues8 treated 14 periprosthetic fractures with a modular distal tapered titanium-alloy stem. There were no apparent treatment failures.

Extended osteotomy of the proximal femur has also been successful in dealing with complex revision problems, such as loose femoral implants, retained bone cement, and proximal femoral deformity.17–19 Younger and colleagues18 pointed out the need to eliminate periosteal stripping and to use rigid cerclage wiring in the revision setting for optimal results. The technique is forgiving, and union rates have been nearly 100%, despite the occasional gap left after reconstruction.

The surgical technique described in this case report is simply an extension of the extended femoral osteotomy. As the implant is often loose or near failure, and osteolytic defects are a primary cause of the fracture, obtaining fracture union is a tenuous affair. Splitting the entire proximal fragment into 2 pieces allows easy removal of the loose implant and provides excellent exposure of the remaining distal fragment. As patients in our series were elderly, an efficient straightforward approach was optimal.

Two important technical considerations bear emphasis. First, Macdonald and colleagues7 and Warren and colleagues20 pointed out the need to cerclage the orifice of the distal fragment tightly to prevent distal splitting with reaming and implant insertion. Warren and colleagues placed 2.0-mm cerclage Dall-Miles cables on the distal femur and found no subsidence of a fluted, tapered femoral stem—compared with a mean subsidence of 6 mm in cases treated with heavy wires.

Second, the surgeon must determine the exact dimensions and special orientation of the distal femoral canal. This determination can be made with direct inspection, but, in certain cases involving distal cement, fluoroscopic control is warranted. Meticulous removal of any retained distal cement or other debris is critical to avoid spoiling the distal canal with eccentric reaming.

Femoral strut allografts have become an important adjunct for fixation and restoration of bone stock of the proximal femur. Results from several studies of these allografts have shown their advantage in improving fixation and bone healing.3,21,22 In the 4 cases of this series, supplemental allograft strut grafts were needed for bulk, so they were placed against the implant and were covered with the remaining proximal femoral fragments. In our experience with allograft, long-term incorporation about stable implants has been excellent.

In the initial cases in our series, we used a fully porous, coated, straight femoral stem. More recently, we used a fluted, tapered titanium modular stem, which seems to have the advantage of obtaining fixation below the isthmus. Preference for this stem is based on its success in treating cases in which the straight stem simply would not have worked below the isthmus. Mechanically speaking, the tapered stem, when inserted into a fixed cylindrical tube, eventually finds a level of stability. The important issues are tube stability, which is a function of the cerclage wires, and the need for a tapered stem large enough to fill the hole. The basic principles remain the same—rigid distal prosthetic fixation, repair of proximal bone fragments about the prosthesis with possible allograft augmentation, and reestablishing appropriate limb length for stability.

This case report highlights a simple detail that enhances use of current implant fixation methods for these most difficult of periprosthetic fractures.

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References
