The Revision Femur: A Potpourri of Options Extensively Porous-Coated Stems in Femoral Revision Arthroplasty

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Femoral reconstruction can be challenging during revision hip arthroplasty. Aseptic loosening and osteolysis can prevent secure fixation of revision femoral components if stability is solely based on the proximal femoral bone. The surgeon must find the best method to secure the implant in a femur with deficient bone stock proximally that will provide stability for load bearing. In revision surgery, the environment for proximal bone ingrowth usually is unfavorable as the proximal femoral bone stock often is deficient, weak, poorly vascularized, and sclerotic.

Efforts to obtain diaphyseal fit, fill, and biologic fixation have led to the development of the fully coated cementless femoral implant. This technique permits reliable biologic fixation at intermediate- and long-term follow up. Over the past several years, a femoral bone loss classification system has been developed. The use of an extensively porous-coated stem during femoral reconstruction is becoming the gold standard in revision surgery.

This article presents a femoral defect classification system and assesses the outcome of fully-coated cementless femoral revision components at minimum 11-year follow-up.

MATERIALS AND METHODS

Between 1984 and 1989, a total of 188 consecutive cementless femoral revision surgeries were performed. Eighteen patients died or were lost to follow-up. The remaining 170 patients underwent follow-up for an average of 14.2 years (range: 11-16 years). Mean patient age was 61.2 years. Reasons for revision included aseptic loosening (82%), septic loosening (8%), periprosthetic fractures (6%), and improper component position (4%).

The femoral bone loss classification system is based on the location and extent of the bone loss. There are four categories of bone loss, type I through type IV (Figure 1).1 Type I defects are minimal. The femur does not differ significantly from that encountered in the primary total hip. Type II defects reveal mostly metaphyseal damage with minimal diaphyseal damage. Type III defects are characterized by metadiaphyseal bone loss. These defects are subdivided into femurs in which a minimum 4-cm scratch fit can be reliably obtained near the isthmus (IIIa) and those in which the scratch fit is obtained more distally (IIIb). Type IV defects represent extensive femoral metadiaphyseal damage with thin cortices and widened canals that preclude reliable distal fixation.

Preoperative radiographs should include an anteroposterior view of the pelvis and AP and lateral views of the hip and femur. Templates are used to estimate the length and diameter of the stem that would obtain a scratch fit over 4-6 cm of cortical bone.

Reconstructions were classified pre- and intraoperatively. The type of femoral defect present predicts surgical reconstruction options.1 Type I defects can be treated with a cemented, proximally porous-coated or extensively porous-coated implant. Type II defects are treated with fully coated stems (6-8 inches) (Figure 2). Type III defects are reconstructed with longer, canal filling, fully porous-coated stems (8 or 10 inches), and type IV defects generally are treated with impaction allografting or an allograft prosthetic composite.

RESULTS

Femoral defects at the time of
surgery are presented in Table 1. Postoperatively, femoral component stability was determined using the criteria of Engh et al for bony ingrowth. Radiographic evidence of bone ingrowth was present in 82% of hips, stable fibrous fixation in 14%, and 4% were unstable. Six stems were revised to larger fully coated cementless implants.

Stem subsidence was present in 27 (16%) patients. Unstable stems subsided an average of 7.1 mm (range: 4-10 mm). There was no progression of stem subsidence after 2 years in all stems that were radiographically stable.

Proximal femoral osteolysis was reported in 23% of femurs but was limited to Gruen zones 1 and 7.5 No diaphyseal osteolysis or secondary loosening from osteolysis was present.

The overall mechanical failure rate in this series, defined as stems requiring additional revision surgery or stems that were radiographically unstable, was 4.1%. Failure of femoral fixation correlated highly with extent of bone loss (especially in cases with diaphyseal bone loss). The failure rate was 5% in patients with type II or IIIA defects and 21% in patients with type IIIB defects.

Complications included 15 (8.8%) intraoperative fractures during stem insertion, 10 (5.9%) perforations or fractures during cement or component removal, 12 (7.1%) dislocations, 3 (1.8%), and 4 (2.4%) sciatic nerve palsy. Two cases of nerve palsy were unresolved.

**DISCUSSION**

Numerous techniques have been developed to revise the failed femoral component. The loss of femoral bone stock in the metaphyseal region makes prosthesis fixation difficult with cemented or proximally coated cementless devices. Cementless techniques in revision femoral arthroplasty have attempted to establish a more permanent, secure, biologic fixation between the remaining host bone and femoral component. Proximally coated cementless implants have been unpredictable in revision surgery, possibly as a result of the demands placed on the compromised proximal femoral bone stock.6

Long-term success of cementless femoral revision is dependent on achieving initial axial and torsional stability by maximizing canal fill at femoral reconstruction. Predictable long-term success can be expected from fully coated cementless femoral revision versus other methods (Table 2).

Current research found stable biologic fixation of femoral components can be maintained in >95% of cases at 11-16-year follow-up. Despite stress shielding and osteolysis in some patients, there were no cases in which this became a clinical problem or compromised femoral fixation. In addition, type IIIB femurs are a subgroup of revision femurs with a lower rate of stable biologic fixation with the fully coated cementless stem. Impaction grafting is a viable alternative technique for revision femoral arthroplasty and may be more successful when revising the type IIIB femoral revision. In type II, IIIA, or I femurs, a fully coated cementless femoral revision arthroplasty remains a reproducible and predictable technique.

**REFERENCES**