Revision Total Knee Arthroplasty Using Large Distal Femoral Augments for Severe Metaphyseal Bone Deficiency: A Preliminary Study

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Abstract

Managing severe structural femoral metaphyseal bone loss in revision total knee arthroplasty is a challenging problem facing the revision knee surgeon. This study assesses the use of large (30 mm) metal distal femoral augments to compensate for severe bone deficiencies. Hospital for Special Surgery scores, Knee Society scores, and range of motion improved after implantation of femoral components with 30-mm distal femoral augments. There was no radiographic evidence of loosening, and no implants had been revised at mean 37-month follow-up. This appears to be an acceptable technique based on the intermediate-term results.

Bone stock deficiency is a common problem in revision total knee arthroplasty (TKA). These deficiencies can be managed with the use of cement, bone grafts (auto- and allografts), modular prostheses with metal augments, and custom prostheses. Most revision knee systems currently in use have modular femoral and tibial components that can substitute for bone loss with metal augmentation blocks or wedges. Femoral condyle augmentation typically is carried out for distal, posterior, or both bone deficiencies. These are the most common locations of significant bone loss found at revision knee surgery.

Distal femoral bone loss or excessive bone resection increases the extension gap, whereas, bone loss on the posterior femoral condyles increases the flexion gap. Substituting for bone loss in these locations is necessary to restore the normal joint line and knee biomechanics. Restoring the normal joint line leads to the correct soft-tissue and muscle tension, including collateral ligament tension (when these ligaments are present), throughout the range of knee motion. Improved biomechanics and stability of revision TKA depend on this principle.

Results of revision TKA using tibial component modular augmentation have been reported. However, to date, no studies have investigated the use of distal femoral augments to restore the joint line in revision TKA with significant femoral condyle and metaphyseal bone loss (>30 mm).

MATERIALS AND METHODS

Patients who underwent revision TKA with metal distal femoral augments for metaphyseal bone deficiencies >30 mm at our institution were included in the study. Data was available for all five patients. All patients in this study were women. Mean patient age was 67 years (range: 60-75 years). Outcome data was obtained prospectively through the use of a research computer database.

One surgeon and one registered physical therapist assessed all patients pre- and postoperatively. Patients also completed pain and function questionnaires preoperatively and at each postoperative visit. Mean follow-up was 37 months. Excluding one patient who was lost to follow-up after 3 months and presumably died due to lung cancer, the remaining four patients had follow-up ranging from 11-84 months.

All five patients underwent revision TKA by the senior author (S.B.G.) at Stanford University Medical Center between November 1992 and December 1998. Indications for revision TKA included periprosthetic osteolysis in one patient, infection (postexcisional arthroplasty) in one patient, recurrent posteri-
or dislocation with bone loss in one patient, nonunion of a periarticular distal metaphyseal femur fracture in one patient with rheumatoid arthritis, and nonunion of a supracondylar femur fracture in one patient with pre-existing osteoarthritis of the knee.

All patients underwent distal femoral augmentation to substitute for femoral condyle deficiencies and to restore the joint line. The Zimmer Insall-Burstein II CCK prosthesis (Zimmer, Warsaw, Ind) was used. A specially ordered 30-mm distal femoral metal augments was implanted in all five patients. The augment fits into the femoral component where it is stabilized with screws. Full cement fixation was used in all patients; no tibial augments were required.

Patients were reviewed clinically at 6 weeks, 3 months, 6 months, 1 year, and then annually after surgery. Knee Society and Hospital for Special Surgery scores were assessed preoperatively and at latest follow-up available. Postoperative radiographs were reviewed for evidence of loosening and wear (Figure).

**RESULTS**

The mean preoperative Hospital for Special Surgery score was 38±13 (range: 18-57). Postoperative scores improved to a mean 71±13 (range: 55-93). Knee Society scores improved from a mean 33±12 (range: 23-55) for the knee score to 78±15 (range: 60-95) postoperatively. Knee Society function scores improved from a mean 9±18 (range: 0-45) preoperatively to 43±31 (range: 0-95) postoperatively.

Range of motion also was assessed by a certified physical therapist. The mean preoperative value was 77°±8° (range: 65°-90°). This improved to 95°±15° (range: 80°-120°) postoperatively.

Radiographic evaluation at average 37-month follow-up (range: 3-84 months) revealed no evidence of loosening or wear in the patients studied. The Table summarizes the results.

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<th>Summary of Results*</th>
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*Values expressed as mean±standard deviation.

**DISCUSSION**

The principles of revision TKA are: 1) restoration of the lower extremity mechanical axis, 2) stable fixation of the prosthesis, 3) restoration of the normal joint line, 4) maintenance of soft-tissue balance in flexion and extension, and 5) providing a functional range of motion for activities of daily living.

The revision knee surgeon often faces distal femoral bone loss when dealing with failed primary TKAs. Most knee systems easily compensate for minor bone loss with augments of 5 or 10 mm for the posterior and distal aspects of the femoral condyles.

This study indicates successful results can be achieved using large metal femoral augments for severe (>30 mm) femoral metaphyseal bone deficiencies. Hospital for Special Surgery and Knee Society scores, as well as range of motion, improved in all five patients. There was no evidence of radiographic loosening or wear identified in the radiographic assessment up to 84 months postoperatively.

The strengths of this study include the fact that one surgeon at one institution performed all of the revisions. All patients had identical peri- and postoperative protocols and rehabilitation. In addition, the available follow-up data is complete as the patients were followed according to a prospective, standardized protocol by one physical therapist.

The main weakness of this study is the small number of patients who were available for review. This, however, is not surprising given the long survivorship of primary TKAs. In addition, the majority of patients undergoing revision TKA have adequate distal femoral bone stock to implant a femoral component with small metal augmenta-
tion at all. This study addresses the problem of revision TKA in situations with severe femoral bone loss due to fracture nonunion, severe osteolysis, or infection.

The use of large metal distal femoral augments in revision TKA is an acceptable method to manage severe femoral metaphyseal bone loss. Significant improvement in all outcome measures studied, including knee scores and range of motion, was demonstrated at mean follow-up. This augmentation technique appears to be a useful adjunct to the revision knee surgeon’s armamentarium. Future studies comparing the use of large metal augments to allograft bone are necessary.

REFERENCES