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Clinical and radiological results of femoral head structural allograft for severe bone defects in revision TKA — A minimum 8-year follow-up

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ABSTRACT

Background: Proper treatment of bone loss is essential for the long term durability of revision TKA. However, the method of choice in managing large bone defects is still under debate. We therefore assessed the mid to long term clinical and radiographic results of revision TKA using a fresh frozen femoral head allograft and a standard condylar implant or varus–valgus constrained prosthesis with a diaphyseal-engaging stem.
Methods: We retrospectively reviewed the records of 27 patients who had undergone revision TKA between August 1997 and March 2003 using a fresh frozen femoral head allograft and a standard condylar implant or varus–valgus constrained prosthesis with a diaphyseal-engaging stem. The median follow-up period was 107 months (range, 96–157 months).
Results: Clinical evaluation revealed that the mean range of motion had increased from 71° to 113° and the mean Hospital for Special Surgery knee score had improved from 46 to 83 points. The overall tibio-femoral angle improved from varus 7.3° to valgus 6.l°. In 26 out of 27 knees, union was demonstrated at an average of seven months postoperatively, and there were no cases of collapse, disease transmission or stress fractures. In one knee, an infection recurred.
Conclusions: Our results demonstrate that femoral head allografts in treatment of severe bone defects are reliable and durable. If possible, less constrained prostheses with diaphyseal-engaging stems should be chosen for increased durability.
Level of evidence: Level IV, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

1. Introduction

In 2002, more than 350,000 primary Total Knee Arthroplasty (TKA) and 29,000 revision TKA were performed in the United States [1]. With the aging population remaining active, these trends are projected to continue. By 2030, the demand for primary TKA is projected to grow by 673% and revision TKA is expected to double by 2015 [2].

Failures in TKA requiring revision surgery are often accompanied by significant bone loss. This is the greatest challenge. There are multiple well known methods in revision surgery for dealing with deficient bone stock such as cement fillings, modular augments, allografts and hinged/tumor prostheses. However, the method of choice in managing large bone defects during revision surgery is still under debate. Worse still, studies with long-term results for determining the best method are not well reported [3–5]. Also, poorly handled bone defect would cause failure of revision TKA. Therefore reliable long-term treatment methods in severe bone loss became necessary.

The purpose of this study was to determine the mid to long term clinical and radiographic results of revision TKA performed using a fresh frozen femoral head allograft and a standard condylar implant or varus–valgus constrained prosthesis with a diaphyseal-engaging stem.

2. Patients and methods

From August 1997 to March 2003, revision TKA was performed on 32 patients in whom a fresh frozen femoral head allograft was used to treat a severe bone defect. Because three patients died and two patients were follow-up losses, we retrospectively reviewed 27 patients.

The group was comprised of 24 women and three men with a mean age of 67.96 years (55–76 years) at the time of revision. The average BMI was 21.95(19.8–25.2). The minimum follow-up period was 96 months (mean, 107 months; range, 96–157 months). The cause of the revision TKAs was aseptic loosening in 18 knees (Fig. 1), instability in six knees, and infection in three knees. The Anderson Orthopaedic Research Institute (AORI) system was used to classify bone defects

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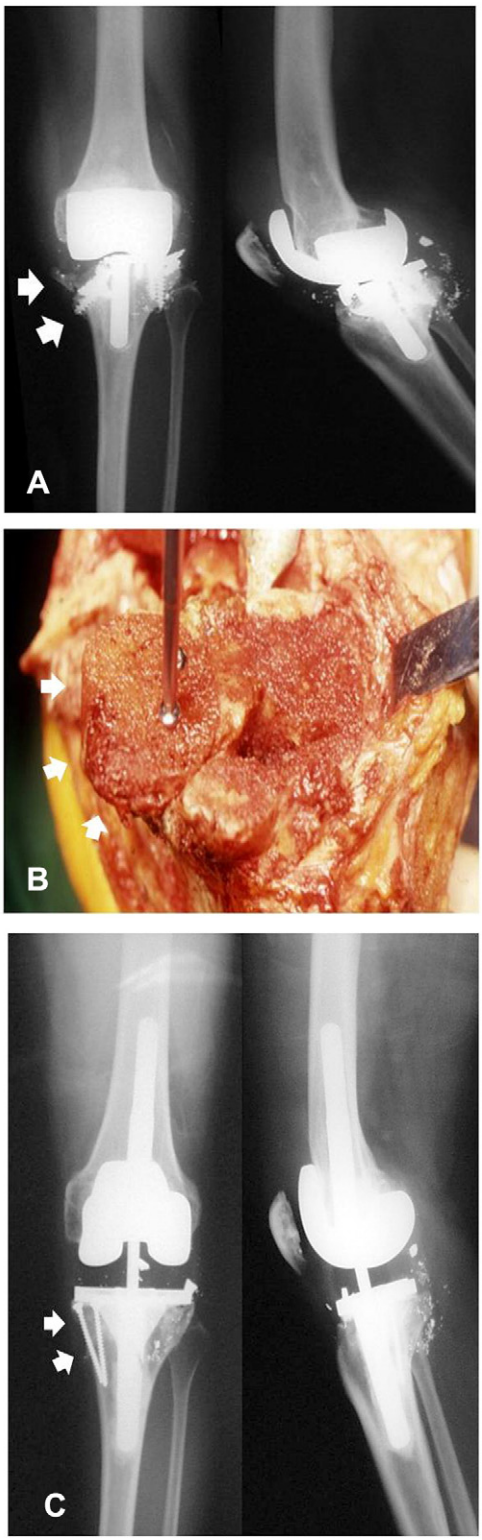

Fig. 1. (A) AP and lateral radiographs show a severe osteolysis in proximal tibia and distal femur with metal breakage (white arrow). (B) The femoral head allograft was stabilized with screw at proximal tibia (white arrow). (C) The allograft remained intact with minimal resorption at six years after surgery (white arrow).

[6]. This classification is based on the morphology of the femoral (F) and tibial (T) bone defects; Type I, intact metaphyseal bone with minor defect; Tpye II, damaged metaphyseal bone; and Type III, the bone defect with detachment of the collateral ligament or patellar ligament. There were seven F2A defects, eleven F2B defects, seven T2A defects, ten T2B defects and three T3 defect. The bone defects requiring a structural allograft included nine proximal tibiae and seven distal femora. Eleven patients had allograft reconstructions on the proximal tibiae and distal femora. All of the bone defects were non-contained type.

The prosthesis types revised included the Nexgen® LCCK (Legacy Constrained Condylar Knee, Zimmer, Warsaw, IN, USA) in 13 cases, the PFC® modular knee system (Press Fit Condylar, Johnson & Johnson, Raynham, MA, USA) in 12 cases and the Nexgen® LPS (Legacy knee PS, Zimmer, Warsaw, IN, USA) in two cases. The use of varus–valgus constrained prostheses was decided by the surgeon intraoperatively in all cases. Ligamentous stability was assessed after inserting a trial component. If collateral ligamentous instability was evident, a LCCK was implanted.

All of these were impacted fresh frozen structural allograft with femoral heads. Femoral heads were obtained from osteoarthritic hips at the time of total hip arthroplasty. The grafts were kept under sterile conditions, according to the protocols outlined by the American Association of Blood Banks [7]. Allografts were packaged and stored at −70°, and transported in dry ice. We used all fresh frozen allografts that stand up to bending, torsion and compression force more than freeze dried allograft. Each allograft was thawed in a warm normal saline solution for 10 min before use. Acetabular reamers were used to prepare the host bed. In the knees that had a revision TKA, the reaming continued until a hemispherical shape was formed to provide the optimum containment of the graft and stability.

Femoral head shapers (Allogrip; Depuy, Warsaw, IN) were used to remove all the cartilage and subchondral bone from the femoral head allograft. The femoral head allograft was reamed to the cancellous level and its diameter was one to two millimeters larger than the size of the bone defect. The graft was then impacted into the recipient site to achieve good approximation of the bone at the allograft–host interface and was temporarily stabilized with Kirschner wires (Fig. 2). The graft was trimmed to the cutting level of the tibia or the femur. The structural allograft was fixed to the bone with cancellous screws. Hybrid fixation with press-fit intramedullary stems was used in all cases. Cement was utilized at implant–allograft and implant–host interface.

Two-stage exchange revision arthroplasty was performed on three cases in which the cause of failure was infection. The first stage consisted of debridement, prosthetic resection and placement of antibiotic-loaded cement beads and spacer. If signs of infection were not observed after treatment with intravenous antibiotics for six weeks, re-implantation was performed.

Stems were used in all cases and stem lengths were selected to be sufficiently long to bypass the host–graft junction and metaphyses and if available the shortest lengths were used to maintain stability as well as to achieve the cortical purchase. In three cases of inappropriate alignment, an off-set stem was used.

Nineteen knees were reconstructed using a femoral head allograft alone. Eight knees were revised using a femoral head allograft and modular metal augmentation. Patellar resurfacing was performed in all cases.

Postoperative management included the use of prophylactic antibiotics for the first 48 h, immediate continuous passive motion therapy, and early range of motion exercises. The patients were allowed touch weight bearing with hinged braces for six weeks starting three weeks after the operation. Depending on the radiographic appearance of the host–graft junction, the patient progressed to partial and full weight bearing.

Follow-ups were performed three months, six months and one year after surgery, and annually thereafter. The clinical outcomes preoperatively and at last follow-up were measured using the Hospital for Special Surgery (HSS) score and measuring the range of motion. The radiographic evaluation was obtained preoperatively, postoperatively as well as at annual intervals. The radiographic evaluation included the standing anteroposterior, lateral and skyline views. The Knee Society Radiographic evaluation and scoring system were used for radiologic evaluation [8]. The tibiofemoral angle was documented. The radiographic analysis