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Long-Term Clinical Outcomes and Survivorship of Revision Total Knee Arthroplasty with Use of a Constrained Condylar Knee Prosthesis

Young-Hoo Kim, MD, Jang-Won Park, MD, Jun-Shik Kim, MD, Hyun-Keun Oh, MD

Joint Replacement Center, Ewha Woman's University School of Medicine, Seoul, Republic of Korea

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ABSTRACT

The purpose of this study was to determine long-term clinical and radiographic results. One hundred and ninety-four patients (228 knees) underwent revision TKA with use of a constrained condylar knee prosthesis. The mean duration of follow-up was 14.6 years (range, 11 to 16 years). The mean pre-revision Knee Society knee scores (43.5 points) and function scores (47.0 points), and Western Ontario and McMaster Universities Osteoarthritis index scores (88 points) were improved significantly ($P = 0.002$) to 85.6, 68.5, and 25 points, respectively, at 14.6 years follow-up. Eighteen knees (8%) had re-revision. Four knees were re-revised for infection. Kaplan–Meier survivorship analysis revealed that the 16-year rate of survival of the components was 94.7% as the end point of loosening and 92% as the end point of revision.

Revision total knee arthroplasty (TKA) presents numerous challenges including stabilization of ligamentous laxity and marked bone loss. To manage some of these challenges, the legacy constrained condylar knee system (modification of the original Total Condylar III design) [1,2] was developed to resist coronal plane moments due to deficient soft-tissue constraints. The issue with constrained condylar total knee prosthesis is the advantage of added stability that comes at the price of potentially loosening due to transfer of forces to the other interfaces. In recent years, authors of several studies have investigated the clinical and radiographic results of revision TKAs with the use of legacy constrained condylar knee prosthesis (LCCK; Zimmer, Warsaw, Indiana) [3–6]. However, most of these studies had less than 10 years of follow-up and included a small number of patients [7,5,8].

The purpose of the current retrospective study was to determine the long-term clinical results of the patients after revision with these constrained prostheses, including the Knee Society knee and function scores [9], the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores [10] and radiographic results including fixation of the components and osteolysis.

Materials and Methods

From January 1995 to February 2003, 424 revision TKAs in 355 patients were carried out by a senior surgeon (YHK). Of the 355 patients, 107 patients were excluded because the constrained condylar knee prosthesis was not used for the revision (107 patients had a revision using a posterior cruciate ligament substitute prosthesis), 28 patients were excluded because they declined to participate, and 15 patients were excluded because they had infected knees. Two hundred and five patients were enrolled and all of these 205 patients required condylar constrained total knee prosthesis to substitute the distal femoral and/or proximal tibial bone defects. Data on 205 patients were entered into the database. However, eleven of the 205 patients were lost to follow-up or died. Therefore, only 194 patients (228 knees) comprised the study (Fig. 1). The study was approved by the institutional review board, and all patients provided informed consent before undergoing revision TKA. We retrospectively reviewed the data for prospectively followed patients. Ninety-seven of the 194 patients (50%) were reported previously, at a mean of 7.2 years of follow-up [3]. The current study group included 168 women and 26 men who had a mean age (and standard deviation) of 65.0 ± 10.4 years (range, 26 to 86 years) at the time of revision surgery. The mean body mass index (and standard deviation) was 26.9 ± 4.1 kg/m^2 (range, 19.1 to 40.5 kg/m^2). The mean follow-up was 14.6 years (range, 11 to 16 years). Previous surgeries were performed once in 110 knees (48%), two times in 88 knees (39%), and three times in 30 knees (13%). Evaluation of bone defect was performed using the Anderson Orthopaedic Research Institute (AORI) bone defect classification [11]. The reason for revision was aseptic loosening with AORI type F2B and/or T2B bone loss in 98 knees (43%), aseptic loosening with AORI type F2A bone defect and/or T2A in 68 knees (30%) and wear of tibial polyethylene with instability in 62 knees (27%). The demographic data on the patients are summarized in Table 1.

Epidural normotensive anesthesia was used for 146 patients (75%), general anesthesia in 41 (21%), and spinal anesthesia in seven (4%). All

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Reprint requests: Young-Hoo Kim, MD, The Joint Replacement Center, Ewha Woman's University, MokDong Hospital, 911-1, MokDong, YangChun-Ku, Seoul, Republic of Korea 158-710.

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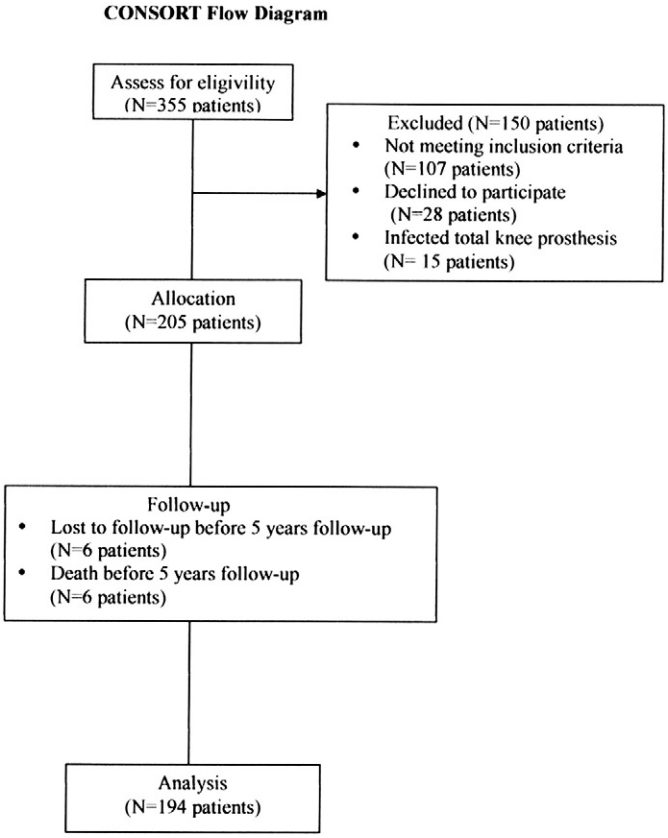

Fig. 1. CONSORT flow diagram.

procedures were performed with tourniquet inflation to 250 mmHg. One hundred and 41 knees (62%) were approached through a previous anterior midline skin incisional scar, and the remaining 87 knees (38%) were approached through a previous medial parapatellar skin incisional scar. All patients received medial parapatellar capsulotomy. A quadriceps snip [12] was required in 164 knees (72%) for adequate exposure. Two knees (0.9%) had a tibial tubercle osteotomy.

All knees were revised with the use of LCCK prosthesis. The indication for using this prosthesis was a bone stock deficiency with insufficient medial or lateral collateral ligaments but an intact, quadriceps mechanism. All of 42 posterior cruciate retaining TKA before revision had an insufficient posterior cruciate ligament and medial or lateral collateral ligaments because of bone defects.

The medullary canal of femur was reamed to the point of mild resistance but not to so-called cortical chatter. A modular stem with distal and/or posterior femoral augments was used to fill the flexion space and to achieve balance with the extension gap. Femoral (lateral and/or medial condyles) augmentation was required in 145 knees (64%) and femoral cone was required in one knee (0.4%). Twenty centimeters long femoral medullary stem was used in 198 knees (87%) and 14.5 cm long femoral medullary stem was used in 30 knees (13%). The osseous surfaces were meticulously prepared with a saw or a high-speed burr to increase surface contact area. Simplex P cement (Howmedica, Rutherford, New Jersey) was digitally pressurized into the metaphyseal bone while the modular femoral component was press-fit in 198 knees (87%) (in these knees, metaphysis and the joint surfaces were cemented and medullary stem was press fitted). In the remaining 30 knees, with severe osteoporosis were fixed using cement in both stem and the femoral cut surface (in these knees, joint surfaces, metaphysis and medullary stem were cemented).

The medullary canal of tibia was reamed to the point of mild resistance but not so-called cortical chatter. Proximal tibial augmentation (medial or lateral plateau) was required in 135 knees (59%). Twenty centimeters long tibial medullary stem was used in 210 knees (92%) and 14.5 cm long tibial stem was used in 18 knees (8%). Two hundred and ten knees (92%) were fixed with so-called hybrid fixation and the remaining 18 knees (8%) with severe osteoporosis were fixed using Simplex P cement in both tibial stem and the proximal cut surface. Average polyethylene thickness was 14.5 mm (range, 10 to 25 mm). The patellae were resurfaced in 203 knees (89%) during the time of revisions, which were not resurfaced during the primary TKA. Twenty knees (9%) were not able to be resurfaced and left alone because of insufficient bone stock. In the remaining five knees (2%), a trabecular patellar prosthesis was used to resurface the patella. All of 203 unresurfaced patellae during the time of primary surgery were found to have denuded cartilage at the time of revision surgery. Twenty knees that were resurfaced during the time of primary TKA were found to have worn of polyethylene patellar prosthesis.

Mean tourniquet time was 71 minutes (range, 45 to 101 minutes) and mean surgical time from skin to skin was 99 minutes (range, 81 to 124 minutes).

A splint was applied with the knee in 15° of flexion and was maintained for the first 24 hours after the operation to relieve pain. Subsequently, the knee then was placed on a continuous passive motion machine twice daily for 30 minutes each time for 10 to 15 days. No

Table 1
Demographic Data on 194 Patients (228 Knees).

Gender (M/F)	26/168
Age[a] (years)	65.0 ± 10.4 (26–86)
Height[a] (cm)	154.8 ± 8.4 (139–178)
Weight[a] (kg)	64 ± 10 (43–92)
Body mass index[a] (kg/m^2)	26.9 ± 4.1 (19.1–40.5)
Primary diagnosis (no. [%] of patients/no. of knees)	
Osteoarthritis	186 (96)/216
Osteonecrosis of the medial femoral condyle	4 (2)/8
Childhood tuberculous arthritis	4 (2)/4
Previous surgeries per knee	1.5 times (1 to 3 times)
Previous surgeries	
1 time	110 knees (48%)
2 times	88 knees (39%)
3 times	29 knees (13%)
Preoperative knee laxity	228 knees
Medial collateral ligament laxity	201 knees (88%)
Lateral collateral ligament laxity	27 knees (12%)
Reasons for revision (no. [%] of knees)	
Aseptic loosening with AORI type F2B and/or T2B[b] bone loss	98 (43)
Aseptic loosening with AORI type F2A and/or T2A bone defects	68 (30)
Wear of tibial polyethylene with instability	62 (27)
Mean duration between primary and revision total knee arthroplasties (range)	12.8 years (8 years to 28 years)
Prosthesis before revision[c] (no. [%] of knees)	
Cementless Miller-Galante	50 (22)
Cementless porous-coated anatomic	48 (21)
Cemented low contact stress	28 (12)
Cemented press-fit condylar	24 (11)
Cemented anatomic modular	24 (11)
Cemented NexGen cruciate-retaining flex	18 (8)
Cemented Scorpio	14 (6)
Cemented Advance	12 (6)
Cemented Omnifit	10 (4)
Duration of follow-up[a] (years)	14.6 (11–16)

[a] The values are given as the mean, with the range in parentheses.
[b] AORI: Anderson Orthopaedic Research Institute.
[c] The NexGen and Miller-Galante Prostheses are manufactured by Zimmer (Warsaw, Indiana); the Scorpio and Omnifit prostheses, by Stryker (Mahwah, New Jersey); the Advance prosthesis is manufactured by Wright Medical (Arlington, Tennessee); cemented porous-coated anatomic prosthesis was manufactured by Howmedica (Mahwah, New Jersey); and the cemented low contact stress, cemented press-fit condylar and anatomic modular prostheses are manufactured by DePuy, Warsaw, Indiana.