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No Difference in Clinical and Radiologic Outcomes After Total Knee Arthroplasty With a New Ultra-Congruent Mobile Bearing System and Rotating Platform Mobile Bearing Systems After Minimum 5-Year Follow-Up

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ABSTRACT

We retrospectively compared the clinical and radiographic results between 76 primary total knee arthroplasties (TKAs) using the e.motion Ultra-Congruent prosthesis and 155 primary TKAs using the Low Contact Stress rotating platform. All patients had a minimum 5-year follow-up. Range of motion, Hospital for Special Surgery score, Knee Society Knee Score and Knee Society Functional Score significantly increased in both groups postoperatively, but there was no significant difference between the two groups. The mechanical femorotibial angle improved in both groups postoperatively. Coronal and sagittal component angles were well maintained at the final follow-up. This study demonstrates that a new mobile-bearing prosthesis, designed to be highly congruent with a rotating bearing, could be considered with theoretical advantages and comparable outcomes of established mobile-bearing prostheses.

Mobile-bearing total knee arthroplasty (TKA) prostheses are characterized by a tibial insert that provides congruent articulation between a metallic femoral component and the tibial tray, thus with the aim to address implant loosening and polyethylene wear typically associated with fixed-bearing TKAs. The axial rotation and gliding motion of the tibial insert in mobile-bearing prostheses could theoretically reduce polyethylene wear by decreasing the contact and subsurface stresses and decrease implant loosening by spreading the load to soft tissue [1–8]. Some reports supported these theoretical advantages that improved mid-term to long-term results in arthroplasty registers [9] and clinical follow-up studies [1,10–16]. Furthermore, the wear rate of the polyethylene tibial insert was lower in the mobile rotating platform compared to the fixed bearing design [17]. However, the results of some studies comparing the two implants reported that mobile-bearing TKA did not affect the radiologic and clinical results [5,7,8]. Recent systematic reviews and meta-analyses also concluded no difference of radiologic and clinical results between two implants [18–21].

New types of mobile-bearing implants have been introduced recently. Among these mobile-bearing implants, the e.motion Ultra-Congruent (UC) prosthesis (B.Braun-Aesculap, Tuttlingen, Germany) is characterized by a rotating tibial insert. This design provides greater congruency between the femoral component and the rotating tibial insert, as well as better stress distribution in the absence of a posterior cruciate ligament. However, few studies have assessed the early results of this implant compared to fixed-bearing implants or former mobile-bearing implant [5,22,23]. Therefore, we retrospectively assessed early clinical and radiologic outcomes of the e.motion UC prostheses after a minimum follow-up of 5 years. We also compared the clinical and radiologic outcomes of this implant with previously established mobile-bearing prostheses like the Low Contact Stress Rotating Platform (LCS RP) mobile bearing knee prosthesis (DePuy, Warsaw, IN, USA). We hypothesized that the e.motion UC prosthesis would result in acceptable clinical and radiological outcomes compared to the LCS RP.

Materials and Methods

This retrospective comparative study of the e.motion UC and the LCS RP was performed according to the guidelines of the Institutional Review Board of our institution (C2013192(1152)/Chung-Ang Univ. Hospital).

Patient Selection

The study retrospectively enrolled 103 patients (138 knees) who received the e.motion UC prosthesis (Group I) and 208 patients (326 knees) who received the LCS RP knee prosthesis (Group II) from January

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2007 to January 2009 who met the following inclusion criteria: (1) underwent primary TKA, (2) had under 15° varus or valgus deformity, and (3) 20° flexion contracture. The exclusion criteria were (1) previous knee surgery including high tibial osteotomy, unicompartmental knee arthroplasty and open reduction with internal fixation, (2) loss of follow-up, and (3) second operated knee in patients operated bilaterally. Twenty seven patients were excluded in Group I due to severe deformity in 9, severe flexion contracture in 3, previous knee surgery in 5 and loss of follow-up in 10. Fifty three patients were also excluded in Group II due to severe deformity in 21, severe flexion contracture in 9, previous knee surgery in 8 and loss of follow-up in 15. Second operated knees of group I (29 knees) and group II (104 knees) were also excluded. Therefore, 76 patients (76 knees) in Group I and 155 patients (155 knees) in Group II were included in our study (Fig. 1). The mean follow-up was 63 months (range, 61–70 months) for Group I, and 66 months (60–72 months) for Group II. Group I patients had diagnoses of osteoarthritis (72 knees) and rheumatoid arthritis (4 knees), while Group II patients had diagnoses of osteoarthritis (149 knees), rheumatoid arthritis (4 knees) and osteonecrosis (2 knees). Mean age, body mass index and range-of-motion at index surgery were not significantly different between the two groups ($P > 0.05$) (Table 1).

Implant Design

The LCS RP prosthesis has no post-and-cam mechanism. Instead, the curved design of the tibial insert articulation surface and a balanced extension/flexion gap provide stability [16,24]. As the LCS RP, the e.motion UC prosthesis is a mobile-bearing prosthesis with a rotating meniscal component and highly congruent design. Both designs have polycentric radii of curvature of the femoral component. The femoral component of e.motion UC has two femoral radii that remain unchanged over a long distance. The distal radius stays constant over a distance of 90° and has areal contact with the tibial insert. It articulates with a rotating tibial insert that has two spherically concave sockets and is flat on the bottom. The tibial insert has anterior build-up and a posterior lip and is lacking the post-and-cam mechanism with highly conforming deep-dished geometry. The large contact surface between the femur and the tibial component provides anteroposterior and rotation stability compared to the LCS RP, and is meant to prevent localized stress peaks and transverse forces [5]. Furthermore, the bearing pin is attached to the tibial tray to prevent tilting of the meniscal component. The specific bearing pin for each tibial insert provides tilt security and allows for better introduction of the gliding surface (Fig. 2). In contrast to e.motion UC design, the tibial insert of LCS RP is allowed to rotate based on the use of a cone that fits into the tibial tray. This feature provide less constraint compared to the e.motion UC. Furthermore, the primary difference between the two designs is the center of rotation of polyethylene tibial insert. The center of rotation in the LCS RP is centrally located, whereas the center of rotation in the e.motion UC is more anterior to accommodate the metal post on the tibial tray.

Surgical Technique

All surgeries were performed by one orthopedic surgeon using a standard medial conventional parapatellar approach through a midline skin incision. A preliminary medial release was performed in a step-by-step fashion to correct deformities. The distal femoral bone and tibial bone cuts were first performed with an intramedullary femoral cutting guide and an extramedullary tibial guide. Both cruciate ligaments were sacrificed in all knees. Soft tissue release was performed to achieve a balanced flexion/extension and medial/lateral gaps that were defined as all gap differences ≤ 3 mm using a sequence of tissue releases for medial, lateral and posterior structures. After confirming the flexion and extension gap balance and patellar tracking, the tibial and femoral components were fixed with cement. None of the patellae were resurfaced. The wound was closed after the tourniquet was released and surgical hemostasis was achieved. An intra-articular suction drain was placed and removed after 2 days.

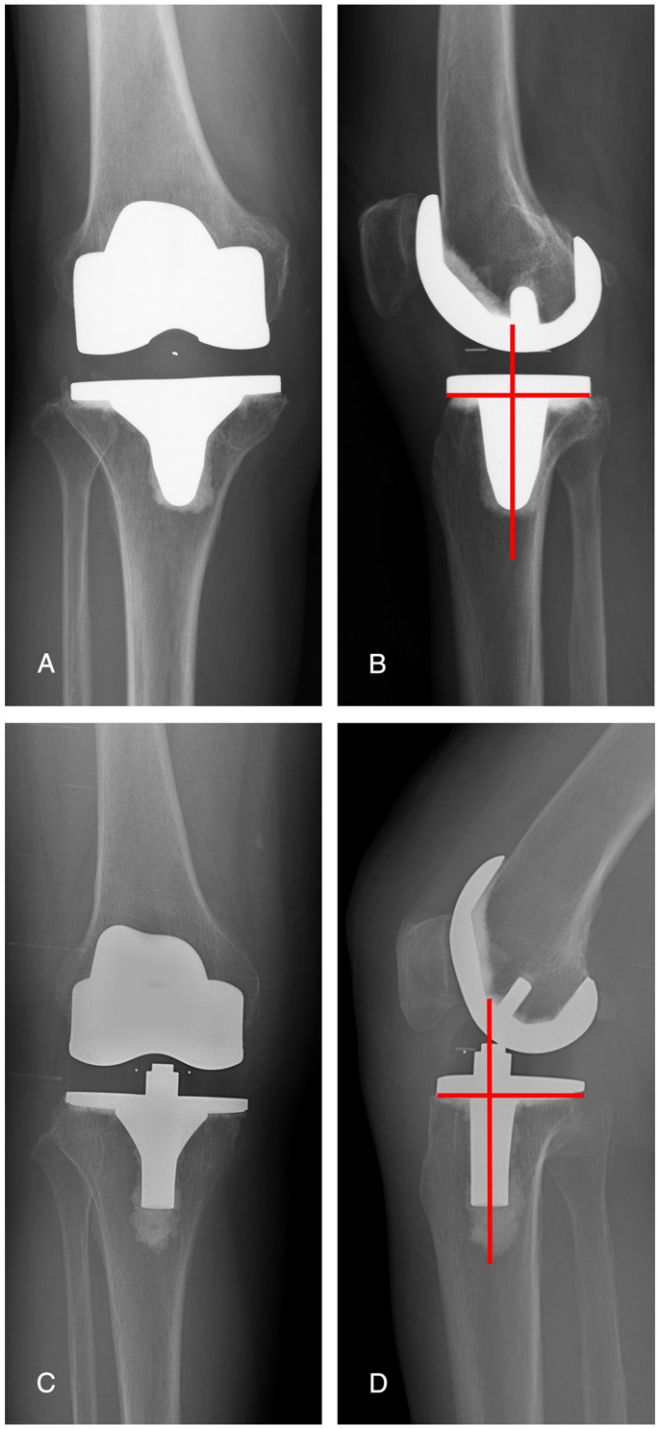

Fig. 1. Radiographs of the prostheses with 5-year follow-up. (A) Anteroposterior view and (B) lateral view show the Low Contact Stress rotating platform mobile bearing system with cone shaped tibial insert and centrally located rotation center (Line). (C) Anteroposterior view and (D) lateral view show the e.motion Ultra-Congruent prosthesis with bearing pin on tibial tray and anterior located rotation center (Line).

The postoperative protocol for both groups was identical. We encouraged straight leg raising exercises after the suction drain was removed. All patients commenced range-of-motion exercises and weight bearing with crutches or a walker 2 days postoperation. Two weeks after the operation, patients were discharged to their home or a rehabilitation center with crutches or a walker.