Editorial

An editorial on "Outcome of unicondylar knee arthroplasty vs total knee arthroplasty for early medial compartment arthritis: a randomized study"

Sara R. Piva, Brian A. Klatt

University of Pittsburgh, Pittsburgh, PA, USA

Correspondence to: Sara R. Piva, PT, PhD. Bridgeside Point 1, 100 Technology Drive, Suite 480, Pittsburgh, PA 15219-3130, USA.
Email: spiva@pitt.edu.

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Both total knee arthroplasty (TKA) and unicompartmental knee arthroplasty (UKA) are used to treat unicompartmental knee osteoarthrosis. Traditionally, TKA was believed to be a better option due to its durability, inclusive patient selection, and robust long-term data on its effectiveness to reduce pain and restore function (1). UKA was initially controversial. Studies conducted from the 1950s to the 1990s reported inconsistent results about the benefits of this surgical procedure (2). It was not until the development of new designs, surgical techniques, and the establishment of appropriate patient selection, around late 1990s, that UKA started to gain more acceptance amongst orthopaedic surgeons (3). Since then, the use of UKA has gradually increased. In the US, the compound annual growth rate in utilization of UKA between 2007 and 2011 was 4.7% (4). The global utilization of UKA is around 6% to 10% of all knee arthroplasties (5,6). The relative low utilization of UKA is mainly due to small number of patients that meet the operative criteria and the technical difficulties of performing the procedure (4).

Despite low utilization, UKA has shown to be beneficial in selective patients with medial compartment knee osteoarthritis. A recent systematic review compared clinical outcomes of UKA versus TKA. That review included only four randomized studies and the results indicated no differences between UKA and TKA for the outcomes of pain, physical function, and knee range of motion. Results also suggested that UKA resulted in 60% lower postoperative complications and 5 times higher revision rates than TKA (7). The Clinical Practice Guidelines for the surgical management of knee osteoarthritis, commissioned by the American Academy of Orthopaedic Surgeons, also reported that UKA increases the risk of revision surgery but decreases the risk of complications such as deep vein thrombosis and manipulation under anesthesia compared to TKA (8). Emerging evidence and data from arthroplasty registries further support lower complications such as transfusions and readmissions (9,10), and higher revision rate for UKA (11-13).

The collective evidence for the comparative effectiveness of UKA and TKA has shortcomings. Most studies have been retrospective, and the few available randomized trials included small number of patients, lacked allocation concealment, did not use intention to treat analysis (14-17), or were conducted over two decades ago (16,17); before the most recent improvements in implant materials and design, surgical technique, and perioperative care. Moreover, most studies comparing UKA and TKA, performed surgeries in one knee only, not considering the bias introduced by the extent of disease/disability on the other knee. Only one study did bilateral UKA or TKA operations, but in a very small fraction (8 out of 48) of their patients, which limits interpretation of results (17). In another study, patients received a UKA in one knee and a TKA in the other during a single anesthetic session (14). However, receiving a UKA in one knee and a TKA in the other is problematic, particularly when the goal is to compare these surgical procedures on functional limitations during activities that

require simultaneous use of both legs such as walking, climbing stairs, and raising from a chair. To date, studies that compare TKA and UKA accounting for disease/disability on both knees are lacking. To that end, in a recent publication in The Journal of Arthroplasty, Kulshrestha and colleagues filled a significant gap of knowledge in knee arthroplasty by testing whether health outcomes are superior for patients who undergo simultaneous bilateral UKA versus simultaneous bilateral TKA (18).

In this randomized study, Kulshrestha *et al.* (18) carefully selected patients willing to undergo simultaneous bilateral knee arthroplasties. To be included, patients had to have: bilateral isolated medial compartment arthritis (complete loss of joint space), functional anterior cruciate ligaments, normal joint space in lateral compartments, <15 degrees of correctable varus on both sides, <10 degrees of fixed flexion deformity on both sides, and no history of inflammatory/infective joint disease, other lower limb pathologies, patellofemoral arthritis of the lateral facets, or knee surgery. Eighty patients were randomized, 40 into the simultaneous bilateral UKA (fixed-bearing limited-incision) group and 40 into the simultaneous bilateral TKA (cemented, posterior-stabilized implant without patellar resurfacing) group. The patients were informed about the planned procedures, and the surgeries were done by a single operating team consisting of two fellowship-trained arthroplasty surgeons at a high-volume specialized arthroplasty center. The primary outcomes were patient-reported outcomes of physical function assessed by the knee outcome survey-activities of daily living scale (KOS-ADLS) and the High Activity Arthroplasty Score (HAAS), and patient satisfaction at 2 years follow-up.

Results of the study indicated similar improvement in KOS-ADLS and HAAS at 2 years in both groups. Preoperative and follow-up KOS-ADLS (scores range from 0 to 100) were 40 and 90 in the UKA group and 43 and 90 in the TKA group. The HAAS (scores range from 0 to 18) was 9 points preoperatively and 12 points at 2 years for both groups. Patient satisfaction pre-surgery was 36% and 34% for UKA and TKA groups respectively, whereas satisfaction at 2 years improved to 59% in UKA group and 56% in TKA group. Performance-based measures assessed by the timed up and go, stair climbing, self-paced walk, and chair to stand tests were also similar between groups. Length of hospital stay was significantly lower in the UKA group (5.4 days) than in the TKA group (6.6 days). Complications and readmission rates were more in TKA group (1 respiratory failure, 2 blood transfusions, 2 complaints of anterior knee pain, 2 delayed would healing, and 2 readmissions—1 for periprosthetic fracture and 1 for manipulation under anesthesia) compared to UKA (2 perioperative fractures).

The strengths of this study include its methods of randomization allocation and concealment (i.e., randomization done by the research coordinator using a computer-generated sequence in a sealed envelope), similarity of demographic and biomedical characteristics between groups at baseline, adequately justified sample size, blinding of testers, low attrition rate of 10% at 2 years, and application of intention to treat principles during data analysis. Additionally, the surgical methods used in the study are aligned with procedures that are widely used in clinical practice, and the description of the peri- and post-operative care of study patients was clear. The investigators also selected a variety of validated and responsive patient-centered outcome measures that included self-reported questionnaires, tests of physical performance, satisfaction, and metrics of healthcare utilization and harm. Using a comprehensive battery of outcome measures provided a more accurate assessment of group differences is younger and more capable individuals.

An innovative component of the design of this study was the choice of comparators. Enrolling patients operated with UKA or TKA in both knees at the same time enabled direct comparison of surgical outcomes between groups while accounting for the severity of disease and functional limitations in both knees. The choice of comparators also helped maintain the needed equipoise in randomized studies. Equipoise was maintained by having experienced surgeons performing both surgical procedures and using surgical procedures (UKA and TKA) of similar expected benefits. Furthermore, emerging evidence for simultaneous bilateral TKA (8,19) and simultaneous bilateral UKA (20) demonstrate similar effectiveness of these procedures as compared to UKA and TKA done during separate admissions.

The choice of comparators discussed above as a strength of the study could also be interpreted as a weakness. That is because the choice of comparators affected patient selection. Only patients to whom simultaneous bilateral UKA and TKA was deemed appropriate were included. The study included suitable patients who could safely be offered those procedures, and, as a result, the patients represent a rather healthy cohort. For example, all patients (except one) had American Society of Anesthesiologists status I (normal healthy patient) or II (patient with mild systemic

disease), and the average age and BMI were 60-year-old and 28 kg/m^2 respectively, which are all below the averages of many studies that compared UKA to TKA (9,11,13,17). Thus, caution is warranted when applying the study results to older patients with more severe disability and multiple comorbidities.

There are other elements of the study that affect the generalizability of study results. First, simultaneous bilateral knee arthroplasties are surgeries that are not frequent. A recent review reported that simultaneous bilateral TKAs represent only approximately 6% of primary TKAs in the United States (21). Second, the results for length of hospital stay may not apply globally. The length of stay reported in the study (6 days) is about twice that of developed countries where the majority of patients stay for less than 3 days in the hospital (22). Additionally, in developed countries, UKAs are generally done as outpatient procedures and the number of outpatient TKAs continue to increase (23). Last, results may not apply to all types of knee arthroplasties. For example, the UKA was a fixed bearing prosthesis, and the results might not be generalizable to a mobile bearing UKA.

Minor weaknesses of the study also include that patients were not blinded to group allocation, which would be very challenging to accomplish given the differences in skin incision for both procedures, and the fact that short-term outcome (<2 years) were not measured. Although 2-year follow-up is the minimal recommended by peer-reviewed journals for studies on arthroplasty, the results from follow-up shorter than 2 years would be helpful to inform whether UKA provides earlier functional recovery compared to TKA, as suggested by non-randomized studies (24,25).

Despite minor weaknesses, the work by Kulshrestha *et al.* provides additional evidence for the comparative effectiveness of UKA and TKA. Both procedures provided comparable good results on patient satisfaction and pain reduction, and excellent recovery of physical function. Although the small sample and short follow-up limited assessment of failure rate, the results contribute to previous literature that UKA results in less complications than TKA. The orthopaedic community recognizes that the ideal patients for UKA are of younger age without a severe systemic disease or comorbidities, who have isolated unicompartmental knee osteoarthritis. TKA is used in all other cases of knee osteoarthritis that require surgical intervention. With such distinction in mind, the information provided by Kulshrestha and colleagues complements the current evidence for UKA and TKA and should be used in shared decision making between surgeons and patients to help decide the most appropriate procedure for those who fit the narrow indications for UKA.

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Footnote

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