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Unicompartmental Knee Arthroplasty vs High Tibial Osteotomy for Knee Osteoarthritis: A Systematic Review and Meta-Analysis

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ABSTRACT

Background: Prior studies have compared unicompartmental knee arthroplasty (UKA) with high tibial osteotomy (HTO) suggesting that both procedures had good clinical outcomes. However, which treatment is more beneficial for unicompartmental knee osteoarthritis is still a controversy. The purpose of our study is to obtain postoperative outcomes of revision rate, complications, function results, range of motion (ROM), and pain between the 2 procedures.

Methods: Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines were followed and study protocol was published online at PROSPERO under registration number CRD42016049316. We searched the databases MEDLINE, EMBASE, Cochrane Library, and Web of Science up to May 2017. Articles that directly compared postoperative outcomes of UKA to HTO were included. **Results:** A total of 10 comparative studies were included in our meta-analysis. UKA patients showed less revision rate, less complications, and less postoperative pain than HTO patients; however, HTO patients obtained more ROM. No significant difference was observed between the group accruing to the knee function scores and excellent/good surgical results.

Conclusion: UKA offers a safe and efficient alternative to osteoarthritis reduced postoperative pain, less postoperative complication, and revision. The 2 surgical techniques showed satisfactory function results for the patients; however, the HTO group achieved superior ROM compared to the UKA group. HTO may be suitable for patients with high activity requirements. Treatment options should be carefully considered for each patient in accordance with their age, body mass index, grade of osteoarthritis, and patients' activity levels.

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Osteoarthritis (OA) of the knee, a common form of degenerative joint disease, affects individuals worldwide. Although OA may affect any one or all 3 compartments of the knee, one-third of OA patients are affected in only 1 compartment [1]. In up to 50% of

patients, arthritic change in the knee is predominately found in the medial compartment of the joint, with fewer changes occurring on the lateral side or patella-femoral joint [2].

Total knee arthroplasty (TKA) is the primary treatment for symptomatic late-stage OA. However, for moderate-grade stages or isolated OA, TKA is not the preferred treatment strategy, particularly for the younger and highly active patients. Unicompartmental knee arthroplasty (UKA) and high tibial osteotomy (HTO) are established treatment methods for moderate medial compartment OA, although choosing the appropriate surgical treatment for unicompartmental OA remains somewhat controversial.

The purpose of this study is to compare the outcomes of UKA and HTO for knee OA by investigating the advantages and disadvantages of these 2 procedures in terms of indications, postoperative complications, functional result, and TKA revision rate.

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Methods

Search Strategy

We conducted this study in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement [3]. The research protocol for this review was determined by all coauthors before the literature searches were begun, and the study protocol was published online at the PROSPERO International Prospective Register of Systematic Reviews (<http://www.crd.york.ac.uk/PROSPERO/>) under registration number CRD42016049316.

The electronic databases MEDLINE (through PubMed), EMBASE (through OvidSP), SCI (through Web of Science), and CENTRAL (Cochrane Central Register of Controlled Trials, through the Cochrane Library) were searched for relevant studies published from October 2016 to May 2017 with no language restrictions applied. The literature search strategy for these 4 databases followed Medical Subject Headings combination with terms.

Inclusion and Exclusion Criteria

Two authors independently assessed the search results for inclusion in this systematic review by scanning titles/abstracts or the full text. Disagreements between the 2 authors were resolved by consensus or through discussion with a third author. We also examined the reference lists of each comparative study and reviews to identify additional relevant studies.

The studies included were randomized controlled trials (RCTs) or nonrandomized controlled trials (nRCTs) that directly compared HTO to UKA to treat medial knee OA and reported at least one of the following outcomes: revision incidence, complications (eg, infection, thrombosis, pain), function results (eg, knee function score or range of motion [ROM]). Cadaver and duplicate studies were excluded. We also excluded studies that evaluated patients with traumatic arthritis and rheumatoid arthritis.

Study Quality Assessment

We assessed the risk of bias in the RCTs using the Cochrane risk of bias tool to determine whether biases might have affected the results. The nonrandomized studies were assessed using the Risk of Bias in Non-Randomized Studies of Interventions (ROBINS-I) assessment tool [4]. The ROBINS-I tool evaluates bias from the following 7 aspects: bias due to confounding, bias in the selection of participants, bias in measurement of interventions, bias due to departures from intended interventions, bias due to missing data, bias in measurement of outcomes, and bias in selection of the reported result. These studies were independently assessed by 2 authors. Any controversy was resolved by a third author to achieve a final consensus.

Data Extraction

The first author extracted data from all included studies, and this process was repeated by 2 other authors. All authors used a standardized data extraction form that included the following topics: (1) study information (ie, author, year of publication, country, journal, and type of study), (2) study population information (ie, age, gender, body mass index [BMI], and OA grade), (3) surgery type and follow-up, and (4) principal outcomes (ie, functional outcomes, ROM, revision incidence, and complications). As for functional outcomes, if the knee score is a maximum of 100 points, then the results are classified in excellent (85–100 points), good (70–81 points), fair (60–69 points), and poor (<60 points).

Statistical Analysis

For dichotomous outcomes, such as complications or revision rates, the odds ratio (OR) and associated 95% confidence intervals (CIs) were used to perform estimates for each study. The mean difference (MD) or standard mean difference (SMD) was used for continuous variables, including knee function scores. For studies that presented continuous data as the means and range values, standard deviations were calculated using statistical algorithms [5]. Only those studies from which the standard deviations and means could be obtained were included in the analysis. Heterogeneity was expressed as P and I^2 . The random effects model replaced the fixed effects model for heterogeneity test, $P \leq .1$ or $I^2 \geq 50\%$.

Sensitivity analysis was performed to evaluate the stability of the results (when necessary), and subgroup analysis was conducted to obtain more specific conclusions if the data were present. Forest plots were used to present the results of the individual studies and respective pooled estimates of effect size. Funnel plots were used to assess publication bias for any of the outcomes. All statistical analyses were performed using Review Manager (version 5.3.5 for Windows, the Cochrane Collaboration, the Nordic Cochrane Centre, Copenhagen, 2014).

Results

Study Selection

A total of 2300 potentially relevant citations were extracted from the 4 electronic databases. After deleting 728 duplicates, 1527 irrelevant citations were excluded by reviewing their titles and abstracts. We reviewed the remaining 45 full-text articles, 14 of which were systematic reviews. We excluded another 17 articles for reasons such as the introduction of a surgical technique, lack of useful outcome data, and for being basic research among others.

Fourteen publications were selected. Of the 2 studies from the same institution that had different follow-up periods, only the recent study was selected [6,7]. The study by Karpman and Volz [8] was excluded because the included patients not only had OA but also had traumatic arthritis and rheumatoid arthritis. The studies by Ivarsson and Gillquist [9] and Weale and Newman [7] were excluded because the indications, expectations, and type of fixation modes varied significantly compared to more recent articles. Finally, 10 studies published from 2001 to 2017 fulfilled the selection criteria and were included in the meta-analysis [10–19]. Screening the reviews and the 10 included articles did not provide any additional studies to evaluate. The detailed study selection process is shown in Figure 1.

Study Characteristics and Quality

Of the 6173 patients (6222 knees) with medial knee OA in the 10 studies, 5305 patients (5335 knees) were in the UKA group and 868 patients (887 knees) were in the HTO group.

Six studies [11,12,15,16,18,19] compared UKA with open-wedge HTO (OW-HTO) and 4 studies [10,13,14,18] compared UKA with close-wedge HTO (CW-HTO). In one study [17], osteotomy was performed using the hemicallotasis technique and in another study [12] dome-type HTO (DT-HTO) was performed using a circular external fixator. The maximum follow-up period was >7.5 years [14] and the minimum period was 2 years [18]. The study characteristics, patient demographic details, and clinic outcomes for each study were shown in Table 1.

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