The Influence of Radiological Severity and Symptom Duration of Osteoarthritis on Postoperative Outcome After Total Hip Arthroplasty: A Prospective Cohort Study

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ABSTRACT

Background: We aimed to investigate the influence of preoperative radiological severity and symptom duration of hip osteoarthritis (OA) on the postoperative functional outcome, quality of life, as well as abductor muscle strength after total hip arthroplasty (THA).
Methods: In this prospective cohort study, we studied 250 patients. Preoperatively, we evaluated the function with the Western Ontario and McMaster Universities Osteoarthritis (WOMAC) index and quality of life with euroqol-5D (EQ-5D). At 1 year after THA, the same scores and also hip abductor muscle strength were measured in 222 patients. We divided the cohort twice, first according to the radiological OA severity [Kellgren-Lawrence classification (KL)] and then according to the OA symptom duration. We investigated whether the preoperative KL class and symptom duration influenced the 1-year WOMAC (primary outcome measure) or EQ-5D and abductor muscle strength (secondary outcome measures).
Results: The crude results showed that KL class and symptom duration had no influence ($P = .90$ and $P = .20$, respectively) on the 1-year WOMAC. Younger age, male gender, and lower body mass index were associated with a better function. Regarding 1-year EQ-5D, the crude results showed that body mass index and KL class had no influence ($P = .83$ and $P = .39$, respectively). The adjusted results showed that only age and gender influenced the postoperative EQ-5D. No influence of the tested factors was found on the 1-year abductor muscle strength.
Conclusion: Preoperative radiological OA severity and symptom duration had no influence on the outcome of THA and should probably not affect the decision about timing the operative intervention.

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Total hip arthroplasty (THA) is a cost-effective and successful surgical intervention for patients with hip osteoarthritis (OA) complaining of persistent pain and disability [1,2]. The main goals of THA are to alleviate pain and improve function and quality of life (QoL). Most patients are satisfied after THA, although this treatment still has its complications. About 10% of THA patients report persistent pain and suboptimal functional outcome at long-term follow-up [3,4]. The absolute number of dissatisfied patients is expected to rise given the increase in the annual number of THA

performed. Therefore, every effort should be made to investigate factors that possibly influence THA outcome. Factors such as age, gender, comorbidities, and body mass index (BMI) have been adequately evaluated in the literature [5,6]. On the other hand, the results of the influence of preoperative radiological severity and symptom duration of OA on the outcome of THA are scarce and contradictory. Nilsdotter et al [7] and Keurentjes et al [8], for instance, showed no influence of preoperative radiological severity on functional outcome and QoL, respectively. Also, Meding et al [9] reported that hip scores at any follow-up were independent of the degree of OA observed on the preoperative radiograph. Contrary to these results, other researchers have found a direct relation between the degree of preoperative radiological severity and postoperative functional improvement, that is, patients with severe OA benefit more than mild OA after THA [10–12]. Regarding symptom

Table 1
The Kellgren-Lawrence Classification.

Class 0: No radiographic features of OA are present
Class 1: Doubtful JS narrowing and possible osteophytic lipping
Class 2: Definite osteophytes and reduced JS on anteroposterior radiograph
Class 3: Multiple osteophytes, definite JS narrowing, sclerosis, and possible bony deformity
Class 4: Large osteophytes, severe/complete JS obliteration, severe sclerosis, and definite bony deformity

JS, joint space.

duration, Ollivier et al [13] showed that symptom duration of <1 year was associated with better return to sport activities after THA compared with longer duration. Apart from that study, we are unaware of any other report on the influence of preoperative symptom duration on THA outcome.

The aim of this prospective cohort study is to evaluate the influence of preoperative radiological severity and symptom duration of OA on the postoperative functional outcome, QoL, as well as clinical assessment in the form of isometric abductor muscle strength measurements. We hypothesized that the more severe the radiological degree and the longer symptom duration would be associated with a greater change in functional outcome and QoL despite weaker abductor muscles.

Patients and Methods

All patients with unilateral primary OA treated with THA at Sundsvall Teaching Hospital in Sweden between September 2010 and December 2013 were considered for inclusion. Exclusion criteria were secondary OA, previous spinal, pelvic, or lower limb fractures, or surgeries.

Before the operation, patients were assessed with the self-administered Western Ontario and McMaster Universities Osteo-arthritis (WOMAC) index that measures functional outcome and the euroqol-5D (EQ-5D) that measures QoL over 5 dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression, together with the patient's rating of their health status using a visual analog scale (VAS). The duration of OA symptoms was documented as less than or longer than 3 years. The body mass index (BMI) was also measured (kg/m^2).

The preoperative plain radiographs were taken within 3 months before the operation. The anteroposterior hip radiograph was made with the patient supine and both legs internally rotated 15° and the X-ray beam centered on the pubic symphysis with film focus distance of 115 cm. The degree of radiological OA was assessed by 2 independent observers (to measure the interobserver reliability) according to the Kellgren-Lawrence (KL) classification (Table 1). One observer repeated the KL assessment 8 weeks later to measure the intraobserver reproducibility. Measurements were calibrated to a 30-mm radiopaque standardized metal sphere (30 mm) to assess the degree of magnification. A 1-mm precision scale was used. According to the KL classification, patients were divided into 2 groups: mild OA (KL 1-2) and severe OA (KL 3-4) [14].

One of 10 specialist orthopedic surgeons or an assistant directly under their supervision performed the operations using either a cemented Lubinus SP II system (Link, Germany) or cementless Spotorno (CLS) stem and Trilogy cup (Zimmer, USA). The Lubinus stem has 1 center collum diaphyseal angle (126°), 32-mm head, and 3 neck lengths (47.5, 51.5, and 55 mm), while the CLS stem has 1 center collum diaphyseal angle (125°), 32-mm head, and 4 neck lengths (−4, 0, 4, and 8). The posterolateral approach was used in all operations. Patients were mobilized at the first postoperative day with full weight bearing allowed and following the same postoperative rehabilitation program.

Patients were followed up at 12-15 months postoperatively with a self-administered WOMAC index and EQ-5D questionnaire in addition to a clinical assessment. During the clinical assessment, the same observer conducted isometric abductor muscle strength measurements in all patients according to the method described by others [15]. Before measurement, information about the test was given to patients to allow them to become familiarized with it. While the patient was in supine position with straight legs on a padded table, the pelvis was immobilized with a band across the iliac spines. An electronic dynamometer (MAV Prüftechnik GmbH) was used. The pad of the compression arm was centered at the lateral aspect of the thigh just below the midpoint between the greater trochanter and knee joint. The patient was then asked to maximally abduct the thigh against the pad. The nonoperated side was tested first. Two trials for each side with a 1-minute rest in between were made. We documented the higher strength measure of the 2 trials for each side and then calculated the percentage of the operated side in relation to the contralateral side.

The primary outcome measure was the WOMAC index, while the secondary outcome measures were EQ-5D, health status VAS, and hip joint abductor muscle strength.

The study was performed in accordance with the Declaration of Helsinki and it was approved by the regional ethics committee at Umeå University. All the patients gave informed consent before participation. The study was registered at ClinicalTrials.gov (identifier NCT NCT02399670).

Statistical Methods

Statistical analysis was carried out using SPSS for Windows version 20.0 (SPSS Inc, Chicago, IL). To calculate the required sample size, a priori power analysis was performed using G*Power software [16] based on comparing the means of the primary outcome WOMAC index of each group. With a power of 0.80 and a significance level (alpha) of 0.05, a minimum of 65 patients was needed in each group to detect a clinically significant 10 points difference [standard deviation (SD) 20] in WOMAC index between the 2 groups. Before using parametric tests, data were tested for normality using the Kolmogorov-Smirnov test. Demographic data were presented as means and SD.

Comparisons between different groups' patient characteristics preoperatively were performed with chi-squared tests (for categorical variables), or independent-samples Student's t-tests or Mann-Whitney U-tests (for continuous variables).

Comparison of preoperative with postoperative scores to evaluate changes over time between the groups of patients with mild and severe OA and between the groups of patients with symptom duration <3 years and >3 years were also done.

To check the influence of different variables [age, gender, BMI, preoperative WOMAC, preoperative EQ-5D, preoperative health status VAS, KL class (1-2 and 3-4), and symptom duration (<3 years and >3 years)] on the primary outcome measure (WOMAC) and on the secondary outcome measures (EQ-5D, health status VAS, and abductor muscle strength), we used analysis of variance to get crude results. We then included the variables that had a P value ≤.1 as potential confounding factors in a multivariable linear regression model for each of the outcome measures to get adjusted results. For these, a P value ≤.05 was considered statistically significant.

The interobserver reliability and intraobserver reproducibility of the KL classification radiological measurements were assessed with the Cohen's Kappa coefficient.

Results

There were 286 eligible patients. We excluded 21 patients who had previous trauma/surgery in the hip or spine. Another