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Original article

Quadriceps strength affects patient satisfaction after total knee arthroplasty

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ABSTRACT

Background: Total knee arthroplasty is one of the most successful surgeries with respect to relieving pain and restoring function of the knee. However, some studies have reported that patients are not always satisfied with their results after total knee arthroplasty. The aim of this study was to determine whether the muscle strength around the knee joint and the walking status influence patients' expectations and satisfaction before and after total knee arthroplasty.

Methods: We evaluated 28 patients who underwent 30 primary total knee arthroplasties from March 2012 to June 2013. We assessed patient-reported scores using the 2011 Knee Society Scoring System, knee extensor and flexor strength, the 10-m walking test, and the timed up-and-go test. All assessments were performed preoperatively and 1 year after total knee arthroplasty. We determined the correlation between the patient-reported scores and each variable.

Results: Preoperative patient satisfaction was significantly correlated with knee symptoms and functional activities, but not with muscle strength or walking status. Postoperative patient satisfaction was significantly correlated with knee symptoms, functional activities, knee extensor strength, and walking status, including the 10-m walking test and timed up-and-go test, after total knee arthroplasty. In stepwise regression analysis, predictors of patient satisfaction with total knee arthroplasty were knee symptoms, functional ability, and knee extensor strength.

Conclusions: Our study demonstrates that pain relief and restoration of functional activity are highly correlated with increasing patient satisfaction after total knee arthroplasty. The results also indicate that the quadriceps is important for patient satisfaction and restoration of functional activity following total knee arthroplasty.

1. Introduction

Total knee arthroplasty (TKA) is one of the most commonly performed orthopedic surgeries. TKA has been successful in decreasing pain, increasing the range of motion (ROM), correcting the alignment of the lower extremity, and improving the functional status of patients. Patient satisfaction was recently recognized as an important measure of health quality among patients with several diseases. However, outcomes as assessed by patient-reported measurements are typically inferior to the satisfactory results obtained by physician-based scoring. Some studies have demonstrated that patient satisfaction after TKA is lower than that after total hip arthroplasty [1,2]. Many factors, including age, pain, function, postoperative alignment, and ROM in the knee joint, are related to patient satisfaction [3–5].

The quadriceps and hamstrings provide functional stability of the knee joint, and their coactivation improves movement efficiency by increasing knee stabilization. The quadriceps affects the movement patterns of the knee during gait in patients with TKA [6,7]. No studies have reported that muscle strength around the

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knee joint or the walk status affects patient satisfaction using patient-reported scoring systems. Therefore, we asked the following questions: (1) Does the muscle strength around the knee joint affect patients' expectations and satisfaction before and after TKA? (2) Does the walking status affect patients' expectations and satisfaction before and after TKA?

2. Patients and methods

We included data on 28 patients (18 with osteoarthritis and 10 with rheumatoid arthritis) who underwent 30 primary TKA procedures from March 2012 to June 2013, and informed consent was obtained. We excluded patients who underwent revision arthroplasty, patients bedridden for reasons other than knee surgery, and patients who underwent another surgical procedure during the study period. Surgery was performed on 12 right and 18 left knees. All TKA procedures were performed with the same surgical approach using a midline skin incision and a medial parapatellar approach. Twenty-eight knees (86.2%) were replaced with a cruciate-substituting design (Bi-Surface knee prosthesis; Kyocera, Kyoto, Japan), one knee (3.3%) was replaced with a posterior-stabilized design (Bi-Surface knee prosthesis; Kyocera), and one knee (3.3%) was replaced with a posterior-stabilized design (Nexgen LPS Flex-Fixed bearing system; Zimmer, Warsaw, IN, USA). The cruciate-substituting design was mainly indicated for patients with small deformities. All patients underwent patellar resurfacing. All implants were fixed by polymethyl methacrylate cement. On the second postoperative day, the patients were allowed to walk, and knee exercises were started with a physical therapist.

Demographic data and primary diagnoses were recorded during the preoperative evaluation. The mean age of the 24 female and 4 male patients was 73.6 years (standard deviation [SD], 7.4 years; range, 60–85 years), the mean body mass index was 25.5 kg/m^2 (SD, 4.8 kg/m^2; range, 16.2–41.7 kg/m^2), the mean height was 150.7 cm (SD, 6.9 cm; range, 140.1–167.0 cm), and the mean body weight was 57.9 kg (SD, 11.5 kg; range, 39.0–94.1 kg). Clinical and radiographic outcomes were collected preoperatively and 1 year postoperatively. The clinical evaluation was performed as part of a standard postoperative protocol. We assessed clinical scores, questionnaire responses, passive ROM, the femorotibial angle, knee extensor and flexor strength, the 10-m walking test (10 MWT), and the timed up-and-go test (TUG).

The questionnaires comprised two patient-reported scores: the 1989 Knee Society Clinical Rating System [8] and the 2011 Knee Society Scoring System (2011 KSS) [9,10]. The knee score and function score of the Knee Society Clinical Rating System, which was introduced in 1989, were assessed by the physician using a scoring sheet. The 2011 KSS questionnaire has four categories: symptoms, patient satisfaction, patient expectations, and functional activities. The patients were asked to grade their symptom expectations, satisfaction, and functional activities using the Japanese version of the 2011 KSS. This version has undergone back-translation, and its reliability has been validated in patients who have undergone TKA [11].

The passive flexion–extension ROM in the supine position was evaluated using a goniometer. The femorotibial angle was measured on a full-leg-length standing radiograph.

The knee extensor strength (KES) and knee flexor strength (KFS) were measured using an IsoForce GT-330 (OG Giken Co., Ltd., Okayama, Japan) during isometric contraction for 3 s. With the patient in a sitting position with the hips and knees at angles of 90°, the force sensor was placed 5 cm above the lateral malleolus (Fig. 1). The torque was calculated by multiplying the measured force by the length of the lever arm (distance between the position of the force sensor and the level of the tibial plateau) and expressed as a percentage of the body weight (Nm/kg). Previous studies have demonstrated the reliability of measuring KES and KFS in the same position [12,13]. Inter-rater reliability analysis using the weighted kappa statistic was performed to determine consistency between the assessors in lower-limb muscle strength. Kappa values were 0.84–0.89. The 10 MWT measures the time it takes a patient to walk 10 m as quickly as possible. This test was conducted on a marked 14-m walkway with 2 m at the start and end that allowed for acceleration and deceleration. It was performed in a standing position. The outcome assessor started a stopwatch when the patient's first foot crossed the 2-m line and stopped it at the 12-m line. The maximum gait speed was then expressed as m/s. The TUG measures the time it takes a patient to rise from an armless chair (seat height of 45 cm), walk 3 m, and turn to a sitting position in the same chair. The patients were instructed to walk as quickly as possible while still feeling safe and comfortable. Both of these tests have excellent interclass and intraclass reliability in older adults and are responsive to changes after TKA [14–16].

Fig. 1. Measuring the knee extensor and flexor strength. The knee extensor and flexor strength were assessed using IsoForce GT-330. With the patient in a sitting position with the hip and knee at an angle of 90°, the force sensor was placed over the anterior part of the lower leg 5 cm above the lateral malleolus. The seat position was adjusted for the length of the legs of each patient to allow him/her to push the pedal as hard as possible.

This study was designed in accordance with the Helsinki Declaration and its consent procedure was approved by the ethics committee of the Kyoto University Graduate School and Faculty of Medicine.

2.1. Statistical analyses

Continuous data are expressed as means, SDs, and ranges, whereas categorical data are presented as absolute numbers and percentages. To compare the baseline and follow-up clinical results, a paired t test was used for continuous data. To identify variables that affected the patient-reported scores of the 2011 KSS, we calculated Spearman's rank correlation coefficient. A p-value of <0.05 was considered statistically significant. Stepwise regression analysis was performed according to backward selection. The backward selection started with all variables that were correlated