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Short-term functional advantages after medial unicompartmental versus total knee arthroplasty

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ABSTRACT

Background: There are many uncertainties about the advantages and disadvantages of using unicompartmental (UKA) versus total knee arthroplasty (TKA) to treat patients with knee osteoarthritis. It is important to have sufficient early postoperative quadriceps strength for long-term, self-reported and gait-related outcomes after knee arthroplasty, but very limited comparative data exist regarding UKA and TKA patients.

Methods: This study assessed isometric quadriceps strength, spatio-temporal gait parameters (walking speed, step length, single-limb support phase) and self-reported outcomes (pain, function, stiffness) in 18 TKA and 18 UKA patients six months after surgery, as well as in 18 healthy controls.

Results: Quadriceps strength of TKA, but not of UKA patients, was lower than that of controls ($P < 0.05$). UKA patients demonstrated better gait function in terms of a longer single-limb support phase than TKA patients ($P < 0.01$), which agreed with better self-reported pain ($P < 0.05$), function ($P < 0.01$) and stiffness ($P < 0.05$) scores compared to TKA patients.

Conclusions: Six months after surgery, UKA patients showed better short-term quadriceps strength and gait function compared to TKA patients, together with less self-reported knee pain and stiffness. Patients eligible for UKA may experience less functional impairments compared to those who require TKA.

1. Introduction

There is ongoing discussion about the advantages and disadvantages of performing unicompartmental knee arthroplasty (UKA) versus total knee arthroplasty (TKA) for the treatment of patients with unicompartmental knee osteoarthritis (OA) [1]. The advantages of UKA compared to TKA include the possibility of a minimally invasive surgical procedure, and preservation of the cruciate ligaments and bone stock. Thus, faster functional recovery of patients may be expected after UKA than TKA.

In terms of muscle function, TKA patients have been shown to have lower quadriceps strength in the operated compared with the non-operated limb [2–4], and also with healthy control subjects six months after surgery. In UKA patients, quadriceps strength of the operated limb has been found to be approximately 10% lower in the operated limb compared with the non-operated limb 1.5 years after surgery [5]. Although it has been argued that the first few months after surgery are particularly important to

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prevent persistent quadriceps weakness after knee surgery [6], short-term recovery of quadriceps strength in UKA patients has not been evaluated and no direct comparisons to TKA are available.

Quadriceps strength is strongly related to functional performance [4] and knee kinematics after TKA [7], and gait kinematics have been shown to approach normal values in TKA patients one year after surgery [8]. However, comparative data about the early recovery of gait parameters between UKA and TKA patients are needed to provide clinicians and patients with guidance about the functional status that is to be expected a few months after knee surgery.

If quadriceps strength and gait would recover quicker in UKA than in TKA patients, this might also be reflected in self-reported outcomes. UKA patients have been shown to have better self-reported outcomes at six months after surgery when compared to TKA patients [9]. While the study by Liddle et al. provided important information about early self-reported recovery of UKA and TKA patients, a combined evaluation of objective (e.g. strength and gait) and self-reported functional outcomes in those patient groups could substantially contribute to understanding the recovery process after UKA or TKA surgery.

Therefore, the aim of the current study was to compare quadriceps strength, spatio-temporal gait parameters, and self-reported outcomes between UKA and TKA patients six months after surgery. Based on the aforementioned advantages of UKA, it was hypothesized that UKA patients would demonstrate better quadriceps strength, gait function, and self-reported functional outcomes compared to TKA patients.

2. Methods

2.1. Subjects

A total of 18 UKA patients, 18 TKA patients, and 18 healthy controls were included in this cross-sectional study (Table 1). Both UKA and TKA patients were consecutively sampled from the postoperative lists of the Schulthess Clinic (Zurich, Switzerland). The sample size was based on expected knee extensor strength differences of 20% between TKA and UKA patients [3,5], with an estimated pooled standard deviation of 20%, a power level of 0.8 and an alpha level of 0.05. The control group was matched for gender, height and weight, and recruited via telephone if, following a study information presentation at a continued education event, they indicated their interest.

The main inclusion criteria for patients were: being age between 50 and 75 years (same for controls), diagnosed with knee OA, and scheduled for unilateral and medial UKA (Sigma High Performance Partial Knee, DePuy Synthes, Warsaw, IN, USA) or unilateral TKA (Innex Total Knee System, Zimmer Biomet, Warsaw, IN, USA) surgery. The cemented prostheses were implanted by experienced in-house surgeons and the mean follow-up time was 6 ± 1 months. Anterior (ACL) and posterior cruciate ligaments were retained in UKA patients but not in TKA patients. There were three exceptions within UKA patients (ACL tear (one patient) or partial tear (two patients) prior to surgery) and one exception for TKA (partial posterior cruciate ligament retained).

Exclusion criteria for both patients and controls consisted of: (1) previous orthopaedic surgery in the lower limbs; (2) a body mass index (BMI) >35 kg/m^2; (3) cardiovascular or pulmonary diseases; (4) inability to walk or climb stairs without an aid; and (5) pain in the lower extremity during walking (only for controls).

All patients followed the same standard inpatient postoperative rehabilitation programme, including: daily mobilization, device-assisted and unassisted walking, and stair climbing during the first days after surgery (UKA: 8.3 ± 2.4 days; TKA: 10.7 ± 2.5 days; mean ± standard deviation (SD)). Thereafter, outpatient physiotherapy continued one to two days per week for a total of 12–16 weeks, where patients underwent massaging, stretching, gait retraining, joint mobility exercises, and low resistance core and lower limb strength exercises.

The study protocol was approved by the local ethics committee (Canton of Zurich, Switzerland) and all subjects signed a written informed consent prior to participation.

Table 1
Subject characteristics by group.

	CG (N = 18)	UKA (N = 18)	TKA (N = 18)
Gender, men/women	9/9	9/9	9/9
Age, years	67 ± 3	61 ± 5[a]	63 ± 5[a]
Body mass, kg	75 ± 16	79 ± 10	81 ± 11
Height, cm	169 ± 8	171 ± 9	173 ± 9
Involved limb, left/right	3/15	10/8	7/11

Involved limb of CG is the limb they would use to kick a ball.
Mean data ± standard deviation (SD).
CG = control group; TKA = total knee arthroplasty.
UKA = unicompartmental knee arthroplasty.
[a] Significantly lower than controls ($P < 0.01$).

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