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Muscle power and function two years after unicompartmental knee replacement

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ABSTRACT

Unicompartmental knee replacement (UKR) is a commonly performed procedure, suitable for one in four patients requiring knee replacement for end-stage osteoarthritis. Recovery and return of function is quicker than with total knee replacement (TKR), but little information is known about the recovery of muscle power. We prospectively studied a cohort of forty four patients undergoing medial UKR to document their functional recovery and leg extensor power. Muscle power was measured using a Leg Extensor Power rig preoperatively and at 1 and 2 years after surgery. Function was self reported using the Oxford Knee Score (OKS) and Tegner Activity Scale (TAS). At 1 year all patients had made significant improvements on all functional measures, with a mean gain in OKS of 15.9 and TAS of 0.84. There were also significant increases in leg extensor power (LEP) of both legs. The mean change in LEP of the operated leg at 1 year was 0.50 W/kg and the non-operated leg was 0.10 W/kg. Between 1 and 2 years there were very slight improvements in strength in both legs, but these were not significant. Compared with healthy age matched normative values, the UKR LEP values at 2 years after surgery were decreased. The recovery of strength and function following UKR had stabilised by 1 year and during the following year further improvements were minimal.

1. Introduction

Unicompartmental knee replacement (UKR) is a commonly performed procedure for treating end-stage osteoarthritis of the knee affecting the medial or lateral compartment. Approximately 5800 UKRs were performed in England and Wales in 2009 [1]. It is reported as suitable for one in four patients requiring knee replacement for end-stage medial compartment osteoarthritis [2]. The procedure is less invasive and is associated with reduced morbidity and shorter hospital stay as compared to total knee replacement (TKR). When appropriate, UKR is the preferred treatment option in particular, in the younger and more active patients who seek to return to physically demanding occupations or pastimes which require the ability to generate lower limb power.

Recovery and return to function in the early stages after UKR have been found to be quicker and range of motion (ROM) improved when compared to TKR [3]. Several studies have investigated changes in muscle strength and power after TKR. These show that the operated leg remains significantly weaker compared to the non-operated leg. The operated leg is also weaker than that of age-matched controls for up to 4 years after surgery [4–7]. This is important for recovery as impairment in quadriceps strength and particularly in power has also been found to be highly correlated with functional outcomes, such as stair rising and walking speed [4,5,7–10]. Functional performance has also been reported to be strongly related to the uninvolved limb's quadriceps strength, which suggests that muscle weakness persists after TKR due to compensation by the non-operated leg [5].

There is, however, less research into changes in muscle strength and muscle power after UKR. Machner et al. showed improvements from pre-operative values in muscle strength as well as voluntary muscle activation in both the operated and non-operated leg at 18 months post UKR [11]. This study included eighteen patients and assessed strength using quadriceps maximum voluntary contraction. All the patients in this study all had a degree of bilateral disease and comparisons were made between the operated and non-operated legs. In their study Fuchs et al. compared patients undergoing UKR with those without knee pathology. They found that at an average of 21 months post-operatively there was a deficit of 30% in flexion and extension strength when UKR patients were compared to healthy controls [12].

In both of these studies patients had extensive rehabilitation post-operatively, for example, 5 weeks of in-patient rehabilitation followed by 2–3 times weekly out-patient sessions for a further 12–16 weeks; which is markedly different to the follow up care generally found in the National Health Service (NHS) in England.

The aim of this study was to prospectively study leg extensor power (LEP) and function in patients undergoing UKR in the NHS setting. This would enable clear documentation of any strength deficits that may remain following this procedure and would be based

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on standard NHS care. This would give a clearer picture for patients and clinicians about what strength gains may be expected following surgery. It was also felt that by using the more functional measure of leg power the results would be more closely linked to post-operative functional performance and therefore help to identify any possible changes needed to current rehabilitation protocols.

2. Patients and methods

The study was approved by local ethics committee (Oxfordshire LREC Reference 07/Q1603/7). Consecutive patients undergoing an elective primary UKR at the Nuffield Orthopaedic Centre, a specialist orthopaedic hospital, were eligible to participate in the study. Patients were recruited in a pre-operative admission clinic providing they had none of the following exclusion criteria: patients undergoing simultaneous bilateral knee replacement, planned TKR, patients where further joint surgery was planned within the following twelve months, patients with inflammatory arthritis, patients whose existing co-morbidities prevented them from participating in the proposed testing protocol and patients who were unable to provide informed consent.

Patients were a convenience sample consecutively recruited over a 1 year period. In total sixty-six patients undergoing UKR were recruited, and forty-four included in the study. The flow of participants and reasons for non inclusion are shown in Fig. 1. All patients received a cemented Oxford medial UKR (Biomet, Bridgend, UK) implanted through a minimally invasive surgical (MIS) approach.

Data was collected by an experienced research physiotherapist (CJ) 6 weeks before surgery, and at 1 and 2 years after surgery. The pre-operative data collection included patient demographic details, height, weight and status of the contra lateral knee – rated as asymptomatic, symptomatic or having already received a joint replacement. This was assessed at 1 and 2 years after surgery.

2.1. Functional activity questionnaires

Two patient based outcome scores were collected: the Oxford Knee Score (OKS) and the Tegner Activity Score (TAS). These scores have both been widely used in previous outcome studies of UKR. The OKS is a patient based questionnaire of twelve questions assessing patient's perception of pain and function of the affected knee joint with an overall score of between 0 (worst) and 48 (best) [13,14].

The TAS is a rating scale of 0 to 10, where the patient selects the highest activity level that he or she can perform, with 0 defined as "no activity, disabled due to knee problems" and 10 as "participation in competitive sport – national and international, elite" [15].

Both of these were self completed by the patients pre-operatively and at 1 and 2 years post surgery.

2.2. Muscle power – leg extensor power

The Leg Extensor Power (LEP) Rig (Bio-Med International, Nottingham UK) which measures the explosive power in a single leg extension [16,17] was used in this study. Prior to the study a pilot reliability study with six patients with UKR had established that the intra-rater reliability was good between testing sessions with an intraclass correlation of 0.90 (0.77–0.96). It is suggested that measures of maximal LEP are of more relevance to function than maximal quadriceps strength measures, as the motion replicates movement patterns that are a common component of such day to day tasks as walking and climbing stairs [16,18].

The LEP Rig consists of a seat and a footplate connected through a lever and chain to a flywheel. [Fig. 2]. To record LEP the patient sat on the seat, arms folded, with their back positioned against the back rest. All participants wore shoes during the tests. The seat position for each patient and for each leg was adjusted to allow full and comfortable knee extension, in conjunction with full depression of the foot pedal. It varied according to the subject's leg length. LEP measurements were

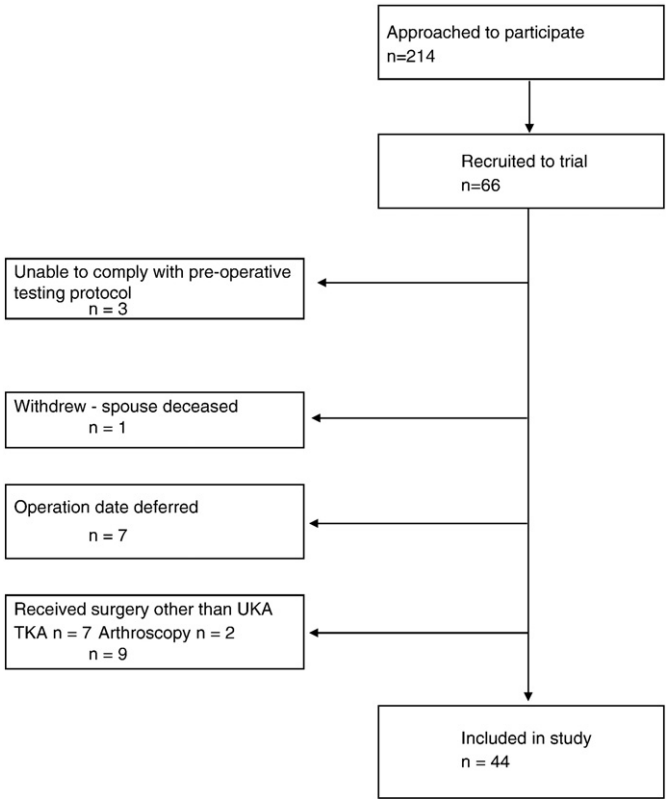

Fig. 1. Flow of patients through trial.