

## SHORT COMMUNICATION

# ABILITY TO RISE INDEPENDENTLY FROM A CHAIR DURING 6-MONTH FOLLOW-UP AFTER UNILATERAL AND BILATERAL TOTAL KNEE REPLACEMENT

Bayram Unver,<sup>1</sup> Vasfi Karatosun<sup>2</sup> and Serkan Bakirhan<sup>1</sup>

From the <sup>1</sup>School of Physiotherapy, and <sup>2</sup>Department of Orthopaedics and Traumatology, School of Medicine, Dokuz Eylül University, Izmir, Turkey

**Objective:** The purpose of this study was to compare extensor mechanism function using a sit-to-stand test in patients undergoing uni- and bilateral total knee replacement, with a 6-month follow-up.

**Design:** Prospective controlled study.

**Patients:** The series included 72 patients with total knee replacement (unilateral 32 patients, bilateral 40 patients).

**Methods:** All patients were evaluated pre-operatively by the physiotherapist and then at 2-weekly intervals during the postoperative 6 months using Hospital for Special Surgery knee score, and range of motion. Extensor mechanism function was evaluated at the same time points using a sit-to-stand test.

**Results:** At the end of study, there was no difference between the groups in their knee range of motion and Hospital for Special Surgery scores ( $p > 0.05$ ). There was a significant difference between the groups in their chair rising ability ( $p < 0.05$ ). At 2 weeks, 22% of patients in the group with unilateral total knee replacement and 20% of patients in the group with bilateral total knee replacement could rise independently. However, there was significant difference in favour of unilateral total knee replacement at 4, 6, 8 and 10 weeks. At 10 weeks, all patients in the group with unilateral total knee replacement and at 6 months all patients in the group with bilateral total knee replacement could rise independently.

**Conclusion:** We conclude that patients with unilateral total knee replacement gain independence earlier than patients with bilateral total knee replacement. However, for patients with bilateral total knee replacement eventually to gain independence, they should be prepared for a longer rehabilitation programme.

**Key words:** arthroplasty, replacement, knee, chair rising, extensor mechanism function, rehabilitation.

J Rehabil Med 2005; 37: 385–387

Correspondence address: Vasfi Karatosun, Erzene Mah 116/16 Sok No:8/12, Bornova, TR-35050, Izmir, Turkey.  
E-mail: vasfi.karatosun@deu.edu.tr

Submitted December 6, 2004; accepted February 21, 2005

## INTRODUCTION

The ability to rise from a chair is an important activity of daily living (1–5). Decreased ability to rise from a chair is important, because it can limit independence or contribute to institutionalization (2). Adequate quadriceps muscle strength is essential for the ability successfully to perform functional activities of arising from a chair and walking (1–6). Technically, total knee replacement (TKR) has developed into one of the most successful procedures in modern medicine. Not surprisingly therefore attention in the TKR community is shifting towards quality of life issues (7). Some studies (3, 7–10) have reported that individuals with TKR experience little or no improvement in functional ability after surgery. This functional impairment has been linked to strength deficits in the extensors of the involved limb (3, 11–13). Functional evidence of knee extensors strength deficits are noted in individuals with TKR during the sit-to-stand (STS) manoeuvre (3, 5, 14–17). The chair rise test is a more focused assessment of extensor mechanism function (6, 16) and is one of the activities used in functional indexes and in test batteries of physical functioning (1). Although, there are several reports in the literature on muscle strength changes following TKR (3, 8, 9, 11, 12, 16–21) careful review revealed only 1 study comparing unilateral and bilateral TKR with regard to muscle strength and functional activities (16). As would be expected, patients who had bilateral TKRs had more difficulty with the chair rise test. However, Mahoney et al. (16), found patients with unilateral TKR gained independence in the STS test later than the bilateral patients, but the type of implant is not homogeneous in the study. Thus, the present study was conducted to compare extensor mechanism function of the knee in uni- and bilateral TKR using the same implant.

## METHODS

The series included 72 consecutive patients with TKR (unilateral 32 patients, bilateral 40 patients). Patients with heart, liver, renal, gastrointestinal or endocrinological disease, malignancy, rheumatoid arthritis, gout, paresis or previous fracture of the lower limbs were excluded. Although the contralateral knees of the patients in whom unilateral replacement was utilized showed radiological and clinical signs to

warrant surgery, it was patients' preference to have unilateral replacement.

All operations were performed by the same surgeon using the paramedian approach. All knees were implanted with cemented, TKR with cruciate retaining (NexGen<sup>®</sup>, Zimmer, USA). After surgery, all patients received standard postoperative treatment by a physiotherapist, including continuous passive motion, active-assistive and active range of motion (ROM) exercises, isometric and isotonic strengthening exercises, gait training and transfer training. After discharge from the hospital a home-based rehabilitation program was applied. The patients were instructed to perform the exercises, and were evaluated every 2 weeks in hospital for examination and instruction of new exercises.

The patients were evaluated by the physiotherapist pre-operatively (SB) and then at 2-weekly intervals (BU) during the postoperative 6 months using the Hospital for Special Surgery (HSS) knee score (22) and knee ROM (23). In bilateral cases, ROM was evaluated separately for the sides. The HSS knee score criteria is based on a total of 100 points. The score is divided into 7 categories: pain, function, ROM, muscle strength, flexion deformity, instability and subtractions. Scores between 100 and 85 points are considered excellent results; scores between 84 and 70 points are good results; scores 69 and 60 points are fair, and scores less than 60 are considered poor results. ROM was determined with a universal goniometry by evaluating range of knee flexion and extension (23). Extensor mechanism function was evaluated at the same time using a STS test (24). Patients were asked to rise from a 40-cm high chair while keeping their arms folded across their chest. Each patient performed 1 practice and 2 recorded trials. If the patient failed to perform the test independently in any occasion, then the test was rated as negative.

The study was approved by the local ethics committee and informed consent was obtained from the patients before inclusion.

The statistical analyses were performed using independent samples *t*-test, paired *t*-test and chi-square test where appropriate. *p*-values less than 0.05 were accepted as significant.

## RESULTS

None of the patients were lost to follow-up. There were no significant differences between the groups for gender, age, height, weight, or body mass index (Table I). There was no difference between the groups in their pre-operative and post-operative HSS score ( $p > 0.05$ ). Average HSS score improved from  $63.0 \pm 11.4$  (range 32–81) to  $86.3 \pm 8.5$  (range 78–96) postoperatively for unilateral TKR, and from  $59.3 \pm 12.7$  (range 31–85) pre-operatively to  $83.3 \pm 9.9$  (range 72–96) postoperatively for patients with bilateral TKR.

There was no difference between the groups in their pre-operative and postoperative knee ROM ( $p > 0.05$ ).

There was a significant difference between groups in pre-operative chair rising ability ( $p < 0.05$ ). Pre-operatively 54% of patients in the group of unilateral TKR and 36% of patients in

Table I. Comparison of the demographic characteristics of the patients pre-operatively. Values are expressed as means with SD within parenthesis

	Unilateral TKR ( <i>n</i> = 32)	Bilateral TKR ( <i>n</i> = 40)
Age (years)	66.4 (8.0)	67.8 (7.0)
Gender (men/women)	2/30	7/33
Height (cm)	159.1 (7.8)	158.6 (6.0)
Weight (kg)	76.1 (13.1)	74.2 (11.4)
Body mass index (kg/m <sup>2</sup> )	27.5 (5.1)	28.2 (5.4)

$p > 0.5$ .

TKR = total knee replacement.

the group of bilateral TKR could rise independently. In the postoperative period there was a significant difference between the groups ( $p < 0.05$ ). At 2 weeks, 22% of patients in group of unilateral TKR and 20% of patients in group of bilateral TKR could rise independently. However, there was significant difference in favour of unilateral TKR at 4, 6, 8 and 10 weeks. At 10 weeks, all patients with unilateral TKR and 87% of bilateral TKR could rise independently. Although the significance between the groups disappeared at 14 weeks, 100% of patients with bilateral TKR gained independence at 24 weeks (Fig. 1).

## DISCUSSION

The inability to rise from a sitting position is recognized by the World Health Organization as a disabling condition (1). STS performance correlates with walking speed, independent ambulation and stair climbing (1). The ability to rise from a sitting position is important for an elderly person to maintain an independent life (1–6, 18). The patients with TKR, who have quadriceps weakness, suggest there is a link between quadriceps weakness and disability (3–5, 11, 15, 21).

Functional abilities of patients in performing activities of daily living can be assessed either patient-reported or performance-based measure. Patient-reported measurement usually relies on visual analogue scales or on questionnaires filled-in by the patient or by the physician. Current performance-based measurement systems (such as electromyography, force platforms, optokinematic systems) however are time-consuming and require sophisticated laboratories (7). The chair rise test is a more focused assessment of extensor mechanism function (6, 16). The benefits of the simple chair rise test of extensor mechanism function are that it requires no special equipment, it requires little additional time, and it can be performed in the examining room as a part of every patient evaluation (16). The chair rise test is one of the activities used in functional indexes and in test batteries of physical functioning (1, 6) showed that the torque required to rise from a chair without use of the arms required 97% of the knee extensor strength.

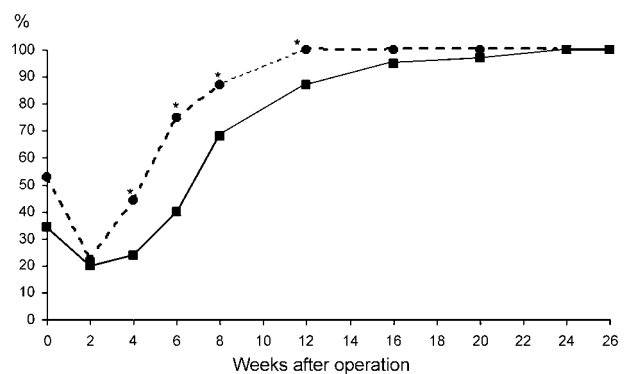


Fig. 1. Comparison of independency level of unilateral (●) and bilateral (■) total knee replacement in sit-to-stand test throughout the study.  
\* $p > 0.05$ .

Moreover, individuals with unilateral or bilateral TKR show deficits in quadriceps strength and inability to rise from a chair, when compared with healthy controls (3, 10, 12, 13, 18), however individuals with unilateral or bilateral TKR have more quadriceps strength and ability to rise from a chair than osteoarthritic individuals (3, 18).

Review of the literature revealed only 1 study comparing uni- and patients with bilateral TKR (16). In this study (16), they found that 94% of the patients with bilateral TKR and 75% of the patients with unilateral TKR gained independency in STS test, 1 year after the operation. This is not in accordance with our results that all our unilateral and bilateral patients gained independence in STS test at 10 and 24 weeks, respectively. The reason of inaccuracy between the results of the present study and the Mahoney et al. (16), may be due to the different types of prosthesis used.

The initial months after TKR appear to be the most critical time for knee extensor strength (3, 18–21). The association between quadriceps strength and disability emphasizes the importance of effective quadriceps exercises in the post-operative management of patients with TKR (18, 21). Our findings suggest that clinicians caring for patients with TKR should monitor quadriceps strength and recommend quadriceps strengthening exercises for maintaining and improving dynamic stability. Having normal quadriceps strength is important in maintaining dynamic stability during the common activity of arising from a chair.

In the present study we followed-up the patients for 6 months, because it is well known that maximum functional gain is achieved in the first 6 months following TKR (4, 6, 11, 19). Our study also showed that all patients achieved 100% independence in the STS test in 24 weeks.

As a result, we conclude that patients with unilateral TKR gain independence earlier than patients with bilateral TKR. However, for patients with bilateral TKR eventually to gain independence, they should be ready for a longer rehabilitation programme. These results may also provide a database for accurate planning of the resources for postoperative rehabilitation programs.

## REFERENCES

- Eriksrud O, Bohannon RW. Relationship of knee extension force to independence in sit-to-stand performance in patients receiving acute rehabilitation. *Phys Ther* 2003; 83: 544–551.
- Gross MM, Stevenson PJ, Charette SL, Pyka G, Marcus R. Effect of muscle strength and movement speed on the biomechanics of rising from a chair in healthy elderly and young women. *Gait Posture* 1998; 8: 175–185.
- Rossi MD, Brown LE, Whitehurst M, Charni C, Hankins J, Taylor CL. Comparison of knee extensor strength between limbs in individuals with bilateral total knee replacement. *Arch Phys Med Rehabil* 2002; 83: 523–526.
- Scarborough DM, Krebs DE, Harris BA. Quadriceps muscle strength and dynamic stability in elderly persons. *Gait Posture* 1999; 10: 10–20.
- Su FC, Lai KA, Hong WH. Rising from chair after total knee arthroplasty. *Clin Biomech* 1998; 13: 176–181.
- Hughes MA, Myers BS, Schenkman ML. The role of strength in rising from a chair in the functionally impaired elderly. *J Biomech* 1996; 29: 1509–1513.
- Van Den Dikkenberg N, Meijer OG, Van Der Slikke RMA, Van Lummel RC, Van Dieen JH, Pijls B, et al. Measuring functional abilities of patients with knee problems: rationale and construction of the DynaPort knee test. *Knee Surg Sports Traumatol Arthrosc* 2002; 10: 204–212.
- Aarons H, Hall G, Hughes S, Salmon P. Short-term recovery from hip and knee arthroplasty. *J Bone Joint Surg* 1996; 78B: 555–558.
- Dickstein R, Heffers Y, Shabtai El, Markowitz E. Total knee arthroplasty in the elderly; patients' self-appraisal 6 and 12 months postoperatively. *Gerontology* 1998; 44: 204–210.
- Finch E, Walsh M, Thomas SG, Woodhouse LJ. Functional ability perceived by individuals following total knee arthroplasty compared to age-matched individuals without knee disability. *J Orthop Sports Phys Ther* 1998; 27: 255–263.
- Berman AT, Bosacco SJ, Israelite C. Evaluation of total knee arthroplasty using isokinetic testing. *Clin Orthop* 1991; 271: 106–113.
- Huang CH, Cheng CK, Lee YT, Lee KS. Muscle strength after successful total knee replacement: a 6- to 13- year follow-up. *Clin Orthop* 1996; 328: 147–154.
- Walsh M, Woodhouse LJ, Thomas SG, Finch E. Physical impairments and functional limitations: a comparison of individuals 1 year after total knee arthroplasty with control subjects. *Phys Ther* 1998; 78: 248–258.
- Jevsevar DS, Riley PO, Hodge WA, Krebs DE. Knee kinematics and kinetics during locomotor activities of daily living in subjects with knee arthroplasty and in healthy control subjects. *Phys Ther* 1993; 73: 229–242.
- Lewandowski PJ, Askew MJ, Lin DF, Hurst FW, Melby A. Kinematics of posterior cruciate ligament-retaining and -sacrificing mobile bearing total knee arthroplasties. An in vitro comparison of the New Jersey LCS meniscal bearing and rotating platform prostheses. *J Arthroplasty* 1997; 12: 777–784.
- Mahoney OM, McClung CD, Cantab MP, Dela Rosa MA, Schmalzried TP. The effect of total knee arthroplasty design on extensor mechanism function. *J Arthroplasty* 2002; 17: 416–421.
- Polo FE, Jackson RW, Koeter S, Ansari S, Motley GS, Rathjen KV. Walking, chair rising, and stair climbing after total knee arthroplasty: patellar resurfacing versus nonresurfacing. *Am J Knee Surg* 2000; 13: 103–108.
- Berth A, Urbach D, Awiszus F. Improvement of voluntary quadriceps muscle activation after total knee arthroplasty. *Arch Phys Med Rehabil* 2002; 83: 1432–1436.
- Lorentzen JS, Petersen MM, Brot C, Madsen OR. Early changes in muscle strength after total knee arthroplasty. A 6-month follow-up of 30 knees. *Acta Orthop Scand* 1999; 70: 176–179.
- Parent E, Moffet H. Comparative responsiveness of locomotor tests and questionnaires used to follow early recovery after total knee arthroplasty. *Arch Phys Med Rehabil* 2002; 83: 70–80.
- Stevens JE, Mizner RL, Snyder-Mackler L. Quadriceps strength and volitional activation before and after total knee arthroplasty for osteoarthritis. *J Orthop Res* 2003; 2: 775–779.
- Alicea J. Scoring systems and their validation for the arthritic knee. In: Insall JN, ed. *Surgery of the knee*. New York: Churchill Livingstone; 2001, pp. 1507–1508.
- Clarkson HM, Gilewich GB. *Musculoskeletal assessment, joint range of motion and manual muscle strength*. Baltimore: Williams & Wilkins; 1989.
- Ranawat CS, Insall J, Shine J. Duo-condylar knee arthroplasty: Hospital for Special Surgery design. *Clin Orthop* 1976; 120: 76–82.