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RESEARCH ARTICLE

FUNCTIONAL MOBILITY ON DISCHARGE DAY AFTER TOTAL KNEE AND HIP REPLACEMENT SURGERY

ABSTRACT

Purpose: To examine functional mobility status on discharge day after total knee and hip replacement surgery in post-acute care hospital setting.

Methods: Eighty patients following total knee and hip replacement surgery were assessed with the de Morton Mobility Index (DEMMI), the Timed-Up-and-Go (TUG) and Five Times Sit to Stand Test, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) measurements of mobility-related activity on discharge day. Demographic information comprised age, body mass index, gender, type of surgery,length of hospital stay. Since the normality of distribution of the data was not confirmed, nonparametric Mann-Whitney-U test was used for analysis.

Results: Forty patients (mean age: 66.83±7.39 years) underwent total knee replacement (TKR) and 40 patients (mean age: 62.63±11.95 years) underwent total hip replacement (THR). No statistical difference was found in age, body mass index and length of hospital stay between patients ($p>0.05$). TKR patients had better results in mean WOMAC total score, WOMAC Physical Functioning Score and mean DEMMI total score compared to THR patients ($p<0.05$). TUG and Five Times Sit to Stand Test time results showed a trend of deterioration in THR patients than TKR patients. The WOMAC pain, stiffness and total scores were similar between TKR and THR patients.

Discussion: Results of this study indicated that functional mobility status at discharge would be better in patients with TKR than THR. Functional mobility evaluation following lower-extremity replacement surgery before discharge should be included in acute clinical physiotherapy practice to guide to physiotherapists to design effective intervention strategies to improve mobility.

Key Words: Osteoarthritis, arthroplasty, hip replacement, knee replacement, early ambulation

ARAŞTIRMA MAKALESİ

TOTAL DİZ VE KALÇA EKLEM REPLASMAN CERRAHİSİ SONRASI TABURCULUK GÜNÜNDE FONKSİYONEL MOBİLİTE

ÖZET

Amaç: Total diz ve kalça eklem replasman cerrahisi sonrası hastane post-akut bakımında taburculuk gününde fonksiyonel mobilite durumunu incelemektir.

Yöntem: Total diz ve kalça replasman cerrahisi olan 80 hasta, taburculuk gününde mobiliteyle ilişkili aktivite ölçeklerinden De Morton Mobilite İndeksi (DEMMI), zamanlı kalk yürü testi (KYT), 5 tekrarlı sandalyeden ayağa kalkma testi ve Western Ontario McMaster Üniversitesi Osteoartrit Index (WOMAC) ile değerlendirildi. Demografik bilgiler,yaş, vücut kitle indeksi, cinsiyet, cerrahi tipi ve hastanede kalış süresidir. Veriler normal dağılım göstermediğinden nonparametrik testlerden Mann-Whitney U testi ile analiz edildi.

Sonuçlar: Kırk hasta (yaş ort: 66.83±7.39 yıl) total diz replasmanı (TDR); 40 hasta (yaş ort: 62.63±11.95 yıl) total kalça replasmanı (TKR) cerrahisi geçirmişti. Yaş, vücut kitle indeksi ve hastanede kalış süresi açısından hastalar arasında istatistiksel farklılık yoktu ($p>0.05$). TDR hastalarının, ortalama WOMAC toplam ve WOMAC Fiziksel Fonksiyon skoru ile ortalama DEMMI total skoru TKR hastalarına göre daha iyiydi ($p<0.05$). KYT ve 5 tekrarlı sandalyeden ayağa kalkma testi zamanları TKR hastalarında TDR hastalarına oranla daha uzun olma eğilimindeydi. WOMAC ağrı, tutukluk ve toplam skorları TKR ve TDR hastalarında benzerdi.

Tartışma: Bu çalışmanın sonuçları, taburculuk sırasındaki fonksiyonel mobilitenin TDR hastalarında TKR hastalarından daha iyi olduğunu göstermiştir. Alt ekstremite replasman cerrahisini takiben taburculuk öncesi fonksiyonel mobilitenin klinikte akut fizyoterapi uygulamalarında değerlendirilmesi, fizyoterapistlere mobiliteyi geliştirici etkili uygulama stratejilerini planlaması açısından yardımcı olacaktır.

Anahtar Kelimeler: Osteoartrit, artroplasti, kalça replasmanı, diz replasmanı, erken ambülasyon.

INTRODUCTION

The aging of the population and increased rates of obesity combining with the increased prevalence of arthritis are creating an increased demand for lower-limb joint replacements (1). Independent mobility is associated with higher levels functional ability and quality of life (2, 3). In contrast, lower levels of mobility has been found to be associated with poorer health outcomes such as higher rates of mortality, health-care costs and requirements for supported care (4). Functional mobility demands include stepping over objects, ascending and descending stairs, performing roll onto side, lying to sit, sitting independently, standing from a chair without using arms, standing independently, standing on both feet, standing on toes, tandem standing, walking distance, walking assistance, picking up a pen from the floor, walking backwards, and jumping (5). All of these activities are compulsive and require adequate mobility which should be improved with rehabilitation following lower-extremity joint replacement surgery. Rehabilitation after surgery starts immediately on the postoperative first days and aims to provide maximal functional mobility.

People who have undergone lower-extremity joint replacement surgery are usually seen at 3, 6, 12 months intervals by their orthopedic surgeon. Monitoring mobility following surgery is a common goal for improving early functional status for physiotherapists. Self-report and performance-based measurements are generally used to assess mobility levels and provide complementary information (6-8). Studies on outcomes of patients with lower-extremity joint replacement generally have focused on comparing available post-acute care providers (i.e. skilled nursing facility, inpatient rehabilitation facility, home health agency...etc.) (9-12). Furthermore, few have examined both self-reported and performance-based outcomes as early as 1 month after replacement surgery to characterize outcomes during early recovery (13). Previous investigations have indicated diminished functional capacity using patient self-report (14,15) and performance tests (16,17) several months to years after surgery. However, no previous performance-based studies have evaluated these functional outcomes as early as on the day of discharge. There is a need to assess overall functional mobility status with timed tests and self-reported measurements at discharge following total knee and hip joint replacement surgery in acute hospital setting.

The aim of this study was to examine differences in functional mobility status between total knee and hip joint replacement surgery on the discharge day. We hypothesized that patients undergoing hip replacement surgery would demonstrate lower functional outcomes compared to patients with knee replacement surgery.

METHODS

Participants

This study was a non-intervention, and exploratory study to determine clinical measures of mobility and self-reports of pain, stiffness and physical function. Ninety-four consecutive patients after unilateral total hip and knee replacement surgery from the orthopedic department within an acute-care hospital setting were included in the study. Exclusion criteria included patients with rheumatoid arthritis, previous lower extremity surgery, infection, revision, severe cardiopulmonary co-morbidities, or neurological problems. Fourteen individuals were excluded from the study based on: rheumatoid arthritis (n=2); higher body mass index (BMI)>40kg/m2 (n=5), diabetus mellitus (n=1) and hypertension (n=2); other joint arthroplasty of either lower extremity (n=4). Of the remaining 80 individuals with end-stage osteoarthritis (OA) of the hip or knee awaiting THA or TKA who initially agreed to participate in the study (Figure 1).

All patients had long-standing end-stage OA of the hip or knee refractory to non-operative treatment and were scheduled for unilateral THA or TKA between December 2012 and December 2013. Each patient was informed about the study and they gave their written informed consent to participate. The study protocol was reviewed and approved by Hacettepe University Ethics Committee (Registration number: HEK12/117).

Surgery

The surgery was performed by the same orthopedic surgeon. In brief, the knee replacement surgical approach consisted of a straight anterior midline skin incision extending from the superior aspect of the

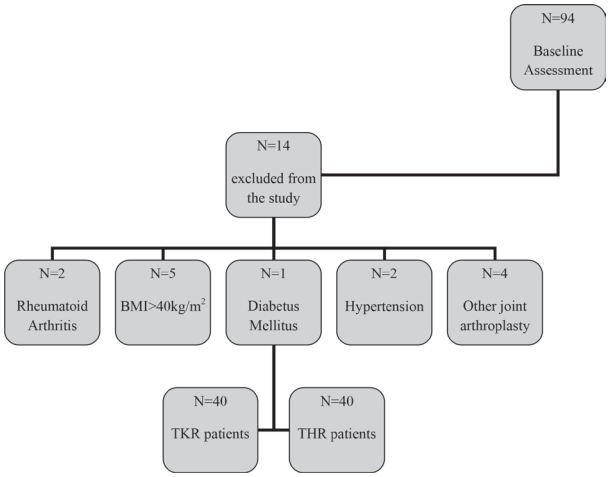

Figure 1. Flow chart of the patients's enrollment in the study.

tibia tubercle to the superior border of the patella. All prostheses were implanted using dedicated smaller instruments including cutting blocks specifically designed for minimally invasive surgery. All the implants were cemented and the same pre- and postoperative rehabilitation protocols were used for each case.

All total hip prostheses were implanted according to a standardized surgical technique. A posterolateral approach without trochanteric osteotomy was used in all hips. In all THA patients, a conventional acetabular full polyethylene Exeter Contemporary cup was cemented, predominantly with an inner diameter of 28 mm and, in some cases, with an inner diameter of 32 mm in combination with a cemented femoral Exeter stem (Stryker Howmedica, Newbury, UK). 49% of the patients had surgery using general anesthesia. 51% of the patients had surgery with spinal/epidural. For the first 24 hours postoperatively, prophylactically, low-molecular-weight-heparin was administered for deep vein thrombosis during the patients' in-hospital stays. Early weight bearing as tolerated was encouraged in all patients. Demographic information consisted of age, gender, body mass index and the type of joint replacement. Length of hospital stay (LOS) was recorded on the Monday following a weekend at discharge. LOS was defined as the number of days between the date of surgery and the date of discharge from the hospital.

Exercises Following Total Knee Replacement

Straight leg lifts, ankle pumps, thigh squeezes, leg slides, progressive knee bending, prolonged knee stretching, heel slides, lying kicks, passive hamstring stretch, knee straightening stretch exercises were performed during hospitalization.

Exercises Following Total Hip Replacement Were Performed During Hospitalization

Ankle pumps, ankle rotations, bed-supported knee bends, buttock contractions, abduction exercise, quadriceps set, straight leg raises, standing knee raises, standing hip abduction.

Usual clinical care consisted of 1 hour of physiotherapy in each day during the patients' stay in hospital. All patients were encouraged to walk to the bathroom and turn back to their beds with a gait aid on the ward (~10 m). Discharge criteria for going home were (1) independent transfer from supine to sit and from sit to stand, (2) safe mobilization with the aid of one or two crutches, and (3) climbing stairs independently and safely. If these criteria could not be met within a reasonable period (aiming at a hospital LOS of 1wk), the patients were referred to an external rehabilitation center. The decision to discharge the patients to the home environment, or to an external rehabilitation center was eventually made by the physician in dialogue with the physical therapist, the nursing staff, the patient, and the patient's family.

Table 1. Demographic Characteristics.

Patient demographics	TKR (n=40) Median (95%CI)	THR (n=40) Median (95%CI)	z	p
Age (years)	68.50 (64.46-69.19)	61.50 (58.80-66.45)	-1.730	0.084
BMI (kg/m^2)	30.00 (28.65-29.96)	30.00 (27.35-39.30)	-1.108	0.268
LOS (days)	6.00 (5.90-7.61)	6.00 (6.37-8.97)	-1.109	0.267

TKR: Total Knee Replacement; THR: Total Hip Replacement; BMI: Body Mass Index; LOS: Length of hospital stay.

Instruments

The de Morton Mobility Index (DEMMI) was used to assess the mobility of the patients. The DEMMI is a reproducible and valid test for accurately measuring mobility levels of older acute hospitalized patients (18). The DEMMI consists of 15 items, which include performing bridge, rolling onto side, lying to sit, sitting independently, standing from a chair without using arms, standing independently, standing on both feet, standing on toes, tandem standing, walking distance, walking assistance, picking up a pen from the floor, walking backwards, and jumping. The tandem standing, picking up a pen from the floor and jumping items of the DEMMI were not applied to the patients due to early stage complications of the lower extremity replacement surgery (e.g. dislocation, falling,...etc). Since the DEMMI is not a self-reported questionnaire, a Turkish-adapted translation is applied by the physiotherapist. The patient is asked to perform these items, and performance of each item is scored on 2- or 3-point response options, resulting in a maximum ordinal score of 19 points. By using a simple conversion scale located on the face of the original DEMMI, the ordinal score can be converted to an interval DEMMI score from 0 to 100, for which higher scores indicate greater independent mobility.

To make familiar with the performance tests, one practice trial was allowed after explaining and showing the tests to all patients. Since all patients can not rise from a chair without using arms on the day of discharge, they were allowed to use their arms during stand up from a modified higher chair in both performance tests. All performance tests were performed by the patients on discharge day.

The Timed-Up-and-Go (TUG) test was used to assess mobility and dynamic balance (19). The test showed excellent test-retest reliability (ICC=0.75) who were scheduled to undergo primary, unilateral total hip or knee arthroplasty, osteoarthritis (20). The patient was asked to rise from a modified armed chair, walk 3 m, turn 180°, and return to sitting position without physical assistance and the time was recorded during the test. Patients were instructed to walk as quickly as they felt safe and comfortable. Patients were allowed to use the arms of the chair while standing up and sitting down. The average of 2 trials was used as the score.

Five Times Sit to Stand Test: We asked patients to complete stand up and sit down as quickly as possible 5 times. The best score was recorded. The sit-to-stand test has been used for people with arthritis and is a valid test (21).

The WOMAC is a self-reported questionnaire measuring physical functioning in older patients with knee or hip osteoarthritis consisting of 3 dimensions: pain (0-20) (5 items), stiffness (0-8) (2 items), and physical functioning (0-68) (17 items). Responses are based on a 5-point Likert scale, from worst to best and the higher scores indicate lower functional status. The Turkish WOMAC index is acceptable, valid, reliable and responsive for use in Turkish patients with knee osteoarthritis (22,23).

Statistical Analysis

SPSS® version 19 (2010, Chicago IL, USA) was used to conduct the analysis. Data were visually analyzed with histograms to test for normality of distribution. This confirmed the use of nonparametric Mann-Whitney-U test. Descriptive data are presented as median and range values based on the normality test. The confidential interval was set at 95%, and the significance level at $p<0.05$. Parameters for a priori power estimates (G*Power Version 3.0.10) were as follows: $\alpha = .05$, $1 - \beta = 0.95$. Ef¬fect size (d) was determined by group means (Mean±SD Group 1: 54.97±13.49; Mean±SD Group 2: 42.67±11.95) and standard deviations using a built-in algorithm in the software. The calculated sample size from the total DEMMI results of statistical power of 0.95 was at least 31 patients in each group (Cohen d = 0.965). Cohen et al. described an effect size of 0.2 as small, an effect size of 0.5 as medium, and an effect size of 0.8 as large (24).

RESULTS

Forty patients (33 female; 7 male; mean age: 66.83±7.39 years) underwent total knee replacement (TKR) and 40 patients (28 female; 12 male; mean age: 62.63±11.95 years) underwent total hip replacement (THR). There was no statistical difference in age (p=0.084), body mass index (p=0.268) and length of hospital stay (p=0.267) between TKR and THR patients. TKR patients had better mobility results in mean WOMAC total score (p=0.054), WOMAC Physical Functioning Score (p=0.008) and mean DEMMI total score (p=0.000) and shorter TUG (p=0.000) and SST (p=0.002) time results compa-

Table 2. Discharge Functional Mobility Status in Patients with TKR and THR

Outcome Measures	TKR (n=40) Median (95%CI)	THR (n=40) Median (95%CI)	z	p
Timed Up and Go Test (s)	29.42 (26.79-38.46)	50.18 (44.87-68.57)	-3.493	0.000*
Five Times Sit to Stand Test (s)	4.59 (4.32-6.05)	7.18 (7.13-11.85)	-3.128	0.002*
WOMAC-Pain (0-20)	10.00 (8.97-11.28)	9.50 (9.37-12.63)	-0.449	0.653
WOMAC-Stiffness (0-8)	4.00 (3.64-5.06)	3.50 (3.41-4.74)	-0.544	0.586
WOMAC-Physical Function (0-68)	40.50 (36.53-45.32)	47.50 (45.12-53.63)	-2.633	0.008*
WOMAC-Total (0-96)	56.50 (49.83-61.07)	61.00 (58.00-68.90)	-1.930	0.054*
DEMMI (0-100)	57.00 (53.66-62.38)	41.00 (37.51-46.13)	-4.793	0.000*

*p<0.05; TKR: Total Knee Replacement; THR: Total Hip Replacement; WOMAC: the Western Ontario and McMaster Universities Osteoarthritis Index (0-68: lowest scores indicates best functioning); DEMMI: the de Morton Mobility Index; CI: Confidential Interval

red to THR patients. The WOMAC pain (p=0.653) and stiffness (p=0.586) were not statistically different between TKR and THR groups (Table 2).

DISCUSSION

The present study characterizes early postoperative functional mobility status in total knee and hip replacement surgery. The principal finding was that patients undergoing hip replacement surgery demonstrated lower functional outcomes compared to patients with knee replacement surgery.

Self-reported questionnaires and performance-based measures were often used in sub-acute (1 to 3 months) and long-term (6 months and 1 year) stages for functional assessment after THR and TKR. Although it is thought that there is no need to compare the clinical functional mobility on discharge day between patients with knee and hip replacement surgery, differences in the functional mobility status need to be determined by physiotherapists for planning different early rehabilitation strategies. In addition, there is no gold standard in the acute orthopedic rehabilitation protocols following lower-extremity replacement surgery. Therefore, in the present study the rehabilitation programs for both groups based on mobility training, range of motion exercises and strengthening exercises in early postoperative stage during hospitalization.

Current rehabilitation protocols are typically aimed at a quick discharge from the hospital. Nevertheless, the length of hospital stay in our study was similar for both knee and hip replacement surgery groups. The mean LOS was 6 days. This LOS is slightly shorter than the LOS in the studies of Hayes et al. (9.5 days) and Dall et al. (8.1 days) (25,26).

Although age and higher BMI were similar in both groups in the present study, the sample was characterized more likely female patients (76%) with higher body mass index, low self-reports of pain, stiffness, and physical function and functional mobility status at discharge.

For a detailed assessment of function, specific tasks evaluations should be taken into account such as standing, rolling onto side, sitting in a chair, standing from a chair, standing, walking forward and backward (27-29). Patients are particularly vulnerable to declining mobility during hospitalization. Therefore, in the present study we used the DEMMI as a primary outcome measure to evaluate functional mobility in the post-acute hospital setting. The DEMMI provides an advanced method for accurately measuring and monitoring changes in mobility in the subacute hospital setting (30). The total DEMMI results showed that TKR patients were able to be more mobile comparing to THR patients on the discharge day.

Timed performance tests have been found to decrease significantly with mobility impairments (23-26,29-31). Residential status and physical mobility status have been determined to be significant predictors of timed performance (27-29). Considering that the predictors are similar for both surgery groups, the THR group had slower results in TUG and SST with more dependent self-reports of pain, stiffness and physical function results compared to TKR group. This result is not surprising, because the knee joint is more stable comparing to hip joint. Generally, THR patients were not allowed to per-

form hip flexion above 90°, hip internal rotation, or hip adduction to avoid the dislocation. Lower extremity exercises and modifications of daily living activities, and mobility training during postoperative hospital stay are essential to protect the hip joint during early stage after surgery. In our opinion, these restrictions might affect the results of the performance-based measurements adversely comparing to TKR patients in THR patients on the day of discharge. Another possible explanation for slower results in THR group might arise from using a modified chair to perform the tests on discharge day to enable dislocation prevention. Furthermore, patients might retain some fears about becoming more physically in early stage after undergoing TKR and THR.

Timed tests such as TUG and SST, indicate that patients after TKR and THR take longer to complete these tasks compared with controls of similar age (23,26,29). There is evidence that, although patients do experience recovery and improvement in strength and functional performance after THR surgery, mobility difficulties and functional deficits remain (31). In addition, during the first few weeks after THR, patients experience hip and knee strength loss and decreased functional capacity, which improve initially, then plateau from 6 months to 1 year. Ouellet and Moffet reported that individuals two months after TKR were 58% slower in completing the timed mobility test compared with healthy controls (32). A minimum of 100 degrees of postoperative knee flexion is desired for a chair rising activity and that a higher chair is more suitable for THR and TKR patients (33). Therefore, it was appropriate to examine the performance of these specific tests with a modified higher chair for both groups. In addition, patients with osteoarthritis and THR mostly report problems with walking and rising from a chair (34-37). In accordance with the literature, in the present study, it was more challenging for THR patients to complete the TUG and SST tests compared to TKR patients. In addition, on a functional level, patients with THR (42%); were slower in completing the TUG, the SST compared with TKR (47%). In addition, TUG and SST results are quite different from the literature due to assessment modification in this study. Patients have suffered from osteoarthritis for many years and might have adapted their lifestyle to the functional limitations during walking, rising from a chair, or stair climbing caused by the disease. After surgery most of these limitations might take time during performance activities to adapt to the new situation. Although patients in the present study report similar results in self-reports of pain and stiffness results in WOMAC, functional mobility deficits that persist indicate that postoperative outcomes could be improved at discharge.

Limitations

One of the major limitations of our study was that we did not assess perceived quality of life in either group, and we did not assess functional mobility preoperatively. Using a comparison group of healthy older adults with repeated-measures design to identify locomotors ability, perceived function, and quality of life would suggest a possible need for improvements in postoperative care. In addition, patients' satisfaction and mini-mental status and contralateral side related to the functional mobility results of joint arthroplasty should have been evaluated. Moreover, some modifications had to be applied during performance tests to provide safety of the patients in acute hospital setting.

In summary, identifying functional mobility impairment in patients with total knee and hip replacement during inpatient, acute stages of rehabilitation may help to predict which patients might struggle with physical function recovery. We suggest that simple tools such as the DEMMI, SST and TUG might be used with some modifications in post acute hospital setting to document mobility and function. It would be better to use more appropriate performance tests such as stair climbing test, timed 10-meter walk test, 2-minute walk test or Iowa Level of Assistance Scale to evaluate mobility and function objectively during hospitalization. Moreover, following total knee and hip arthroplasty, physical therapists must evaluate patient readiness to safely begin to perform these functional mobility instruments. Functional mobility status on discharge should be evaluated with cost-effectiveness and patients' satisfaction following lower extremity replacement surgeries for further studies.

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