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PART II. PHYSICAL ACTIVITY OF SOCIAL AND PROFESSIONAL GROUPS

ACTIVITY LEVEL AND QUALITY OF LIFE AMONG PATIENTS UNDERGOING KNEE REPLACEMENT SURGERY

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Authors' contribution
A. Study design/planning
B. Data collection/entry
C. Data analysis/statistics
D. Data interpretation
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Summary

Knee osteoarthritis (OA) is a widespread disease in Hungary. For severe cases, knee replacement surgery is the last-stage intervention to reduce pain and improve the quality of life. Nevertheless, there is no information about the activity level of Hungarians with severe knee OA. This study evaluated the improvement in the quality of life pre-post knee replacement surgery among Hungarian patients. This study included eight participants (70.8±4.5 years and 30.0±3.0 kg/m^2) with severe knee OA undergoing total unilateral knee replacement surgery. The activity level was evaluated with ActivPAL and Short Form-36 one month before surgery and one year after surgery. One year after surgery, the sedentary time and standing time had significantly improved among the patients by 12% (p=0.033) and 65.7% (p=0.030), respectively. The number of steps improved by 17.1% (p=0.11) based on ActivPAL. Based on the Short Form-36, the overall score, pain, and physical function had improved after one year by 50.0% (p=0.050), 23.9% (p=0.32), and 5.1% (p=0.58), respectively. This is the first study in Hungary that used both objective and subjective tools. The outcomes found that the activity level and pain improved after surgery among Hungarian patients with severe knee OA. However, the sedentary time after the surgery should be reduced to reach the maximum benefits of surgery.

Keywords: knee osteoarthritis, knee replacement, knee, physical activity, quality of life

Introduction

Knee osteoarthritis (OA) is one of the most common diseases among the elderly population globally, as it is associated with age and obesity [1-3]. In Hungary, the prevalence of knee OA was 16.54% in 2011. In a group aged 20-67 years, a total of 2.9% had severe OA [3]. The core symptoms associated with knee OA are pain, low physical activity (PA) levels, and disabilities [1-3].

Conservative treatments, such as pharmacological treatment, orthotics, physiotherapy sessions, manual exercises, acupuncture, and other possible interventions, could be effective for mild-moderate knee OA [4-8]. Total knee replacement (TKR) surgery is the gold-standard treatment to deal with severe knee OA when the pain is no longer relieved by conservative treatments [9,10]. Thus, the expected goals of TKR surgery are reducing pain and improving the quality of life (QOL) [9-11].

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Case description

In Hungary, pain and PA after TKR were evaluated only once using four forms of questionnaires: the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), a short form questionnaire (SF-36), the Knee Society Score (KSS), and a self-made questionnaire [12]. A conference paper reported the QOL before the surgery and six weeks after the surgery and found that the QOL had significantly improved after six weeks from the surgery [12]. However, unfortunately, the full article of this conference paper is not available, some information about the patients' characteristics, numbers, and methodology are missing, and six weeks are not enough to evaluate the QOL improvement. Furthermore, the questionnaires used to assess the PA of patients with knee OA are associated with recall bias and have low-moderate reliability and validity [13,14]. Hence, it was necessary to evaluate the PA of Hungarian patients with severe knee OA using high validity and reliability objective tools, as no databases are available in this field in Hungary. To our knowledge, no study has explored the PA level of Hungarian patients before and after surgery using objective tools or has explored the PA level of Hungarian patients before and after surgery in terms of the number of steps, sedentary time, standing time, and stepping time using a high validity and reliability accelerometer such as ActivPAL. This information is important to understand the PA level and physical behavior of Hungarian patients with severe knee OA before and after surgery using objective tools.

Therefore, the aims of this case-series study were (a) to understand the activity level of Hungarian patients with severe knee OA and (b) to evaluate the activity level of Hungarian patients one year after TKR surgery. The measured variables were evaluated with both objective and subjective monitoring tools.

Study design

This study is a case series study that evaluated the QOL and activity level one month before surgery and one year after surgery among eight Hungarian patients (four females, four males) with an average age of 70.8±4.5 years old and 30.0±3.0 kg/m^2 (Table 1).

Table 1. Demographic data of the participants

Domains	Total (n=8)
Age (y)	70.8±4.5
Gender	4 males, 4 females
BMI (kg/m^2)	30.7±4.3
Smoking	0
Heart problems	3 (2 males, 1 female)
Diabetes	2 (1 male, 1 female)
Hypertension	6 (2 males, 4 females)

Subjects

The inclusion criteria were the presence of a clinical and radiological diagnosis of OA that required knee replacement surgery. The confirmation of a radiological diagnosis was performed by the same orthopedic surgeon at the orthopedic clinic, at the University of Pécs, to ensure that participants needed knee replacement surgery. Participants were excluded if they had had hip and ankle injuries in the previous five years or if they had co-morbidities or medical conditions that affected PA, such as congestive heart failure or cognitive impairment.

PA measurement tools

The activity level was evaluated with ActivPAL and a short form (SF-36) questionnaire. ActivPAL (PAL Technologies, Glasgow, UK) is a uniaxial accelerometer (20 g) that calculates the time spent in sedentary, standing, upright, and stepping states and the number of steps per day for up to 14 days [15-19]. ActivPAL is recommended to be used with the elderly more than other monitors, such as ActiGraph, because it has a higher validity and reliability to detect body movement at different speeds than ActiGraph [19,20]. Before use, the monitor was charged and activated with ActivPAL3™ (version 8.11.9.100). Moreover, the Hungarian version of the short form (SF-36) was used to assess QOL. This form is composed of 36 items about eight domains: physical functioning, physical role, bodily pain, general health, vitality, social functioning, emotional role, and mental health. Each question is scaled between zero (poor health status) and 100 (no problem at all) [21-23].

Intervention and TKR surgery

All of the participants underwent the operation with the medial parapatellar approach that was performed by the orthopedic surgeon. Various prosthetic knee types were used, such as S and N Genesis II, Johnson and Johnson PFC sigma, and Zimmer Nexgen. No compliances were reported after the surgery. The patients stayed five to six days at the hospital after the surgery. Physiotherapy sessions were standardized according to hospital protocols to minimize confounding factors for both inpatient and outpatient periods (for three months only).

Data collection procedure

One month before the surgery, all participants were briefed about the study first and signed the consent form. Then, each participant was asked to complete a Hungarian language SF-36 form one month before the surgery. At that session, the participants were instructed to wear the ActivPAL for seven days most of the time (removed during shower time or water activities). The monitors were set to start measuring the PA from the second day of that visit for seven days. The instructions were given verbally and written to ensure that they understood the instructions. The ActivPAL was attached at the mid-thigh with self-adhesive tape under the clothes. The participants were asked to return the monitor on the day of the surgery.

One year after the surgery, the participants were asked to visit the clinic for follow-up, fill out the SF-36, and use the ActivPAL for one week. The same previously mentioned instructions were given again to each patient. Then, the participants were asked to return the monitor after one week of usage by post.

Data analysis

For data from the SF-36 questionnaire, the average (±SD) of physical functioning, physical role, pain, general health, and the overall QOL score were calculated for each participant at all assessment time points, as these aspects are the most relevant aspects for the study's goal. The data from the ActivPAL were extracted from the monitor using the software. Then, the downloaded files were imported into Excel. The average (±SD) sedentary time, standing time, stepping time, and the number of steps were calculated for each participant at all assessment time points during the testing period (6-7 days). A valid day is defined as 10 hours of continuous activity with less than three hours of interruptions. All the data were analyzed by SPSS (SPSS Inc., Chicago, IL, USA) using a paired sample test. Significant results were considered if the significance (2-tailed) value was less than 0.05 [24]. Only eight patients were included in the paired sample t-tests. The data were normally distributed based on the Kolmogorov-Smirnov test [25].

Results

Ten participants initially took part in this study. After one year, one participant was not available for the final study, and the ActivPAL data of one participant were not included in the pre-surgery data because his data were not valid. Thus, eight participants completed the SF-36 form and had valid ActivPAL data for this study (Tables 2 and 3).

Table 2. The average (±SD) of the activity level one month before and one year after the TKR surgery based on ActivPal

Domains	Pre-surgery	One year post-surgery	Significant (*p*-value)	95% Confidence interval for differences (IC)	
				Low	High
ActivPAL data (pre-surgery n=8, post-surgery n=8)					
Time of sedentary (hour)	18.3±1.9	16.1±3.1	0.033	0.24	4.1
Time of standing (hour)	3.5±1.4	5.8±2.7	0.030	-4.22	-0.11
Time of stepping (hour)	1.5±0.6	2.2±0.9	0.046	-1.2	-0.01
Number of steps (number)	6270±2754	7344±3331	0.11	-2507.04	358.0

Notes: The number of paired samples is eight.

Table 3. The average (±SD) activity level one month before and one year after the TKR surgery is based on the SF-36

Domains	Pre-surgery	One year post-surgery	Significant (*p*-value)	95% Confidence interval for differences (IC)	
				Low	High
SF-36 score (pre-surgery n=8, post-surgery n=8)					
Overall score	50.0±26.7	75.0±23.1	0.050	-49.9	-0.19
Physical functioning	58.1±20.8	61.2±21.5	0.582	-15.5	9.6
Role limitations due to physical health	46.8±41.0	43.7±7.4	0.89	-50.9	57.2
Bodily pain	41.8±23.5	51.8±25.1	0.32	-32.3	12.7
General health	52.5±11.6	56.2±20.6	0.704	-26.1	18.6

Notes: The number of paired samples is eight.

ActivPAL results

The PA level was enhanced after one year of knee replacement surgery based on an objective monitor (Table 2). Before the surgery, patients spent 3.5±1.4 hours per day and 5.8±2.2 hours per day standing after one year of the surgery (65.7%, p=0.030). The stepping time also improved by 46.6% (p=0.046) one year after surgery. Furthermore, the number of steps increased from 6270±2754 to 7344±3331 but insignificantly (17.1%, p=0.11). One year after the surgery, patients spent 2.2 hours per day (12%, p=0.033) less on sedentary activity than before the surgery.

SF-36 results

The total QOL score of the patients was 50.0±26.7 before the surgery and improved to 75.0±23.1 one year after the surgery (p=0.05) (Table 3). The bodily pain based on this questionnaire increased from 41.8±23.5 to 51.8±25.1 (23.9%, p=0.32). Furthermore, role limitations due to physical health increased by 6.6% (p=0.89). In addition, physical functioning and general health one year after knee replacement surgery improved by 5.1% (p=0.58) and 7.0% (p=0.70), respectively.

Case analysis

This study measured the activity level before and one year after TKR surgery among Hungarian patients. To our knowledge, this study is the first study in Hungary that used a highly valid objective accelerometer to understand the PA level of Hungarian patients with severe knee OA and their PA improvement one year after TKR. This study found that Hungarian patients with severe knee OA spend most of their daily time in a sedentary manner, with an average of 18.3±1.9 hours per day, and that they only spend almost 1.5±0.6 hours per day walking, with an average of 6270±2754 steps per day. After one year of TKR, Hungarian patients have better PA levels and less pain (less pain or a better QOL in general) based on both objective and subjective tools.

Hence, the activity level increased between 65.7%-12% based on the ActivPAL and between 50%-5.1% after the surgery. However, the sedentary time decreased from 18.3±1.9 to 16.1±3.1 hours per day, and these changes are still not enough to allow Hungarian patients to meet the general PA guidelines [26].

Few studies have evaluated the PA using the same accelerometer with a one-year follow-up [27,28]. Bin Sheeha et al. [27] evaluated the PA of 33 patients before surgery and one year after. This study found that the stepping time and the number of steps improved significantly by 38.77% and 45.6%, respectively [27]. Moreover, Lützner et al. [28] evaluated the PA level of 97 patients before knee surgery and one year after using ActivPAL. This study found that the number of steps improved by 20.3% (from 5278±2999 to 6473±3654 steps/day), and no changes were seen in the sedentary and stepping time one year after the surgery. However, this result could be due to applying the ActivPAL over the tibia, which is a less reliable position, and the monitor was used for just four days [28].

Furthermore, this study found that the PA of Hungarian patients was improved based on the SF-36 questionnaire. The total score of the SF-36 questionnaire significantly improved by 50% (p=0.050) one year after surgery. Similarly, among Greek elderly women, the total SF-36 score significantly improved from 29.33±11.3 before surgery to 62.35±2.7 six months after surgery [29]. It seems that Hungarian patients have higher PA levels than Greek patients before and after surgery. This finding could be due to the very severe pain the Greek patients had before surgery, as 85% of them had continuous severe pain before the surgery [29]. Other studies used different types of questionnaires. For instance, Granat et al. [27] found that PA based on the Oxford knee score (OKS) significantly increased by 142% (p=0.00) one year after surgery. Additionally, the OKS score improved six months after surgery from 12 points to 42 points [30].

In summary, the activity level and pain among Hungarian patients with severe knee OA improved after one year of TKR. However, the changes were not enough to meet the general PA guidelines. Long follow-ups and staying active after surgery are still necessary to obtain better outcomes. These findings could be important for therapists who care for Hungarian patients with severe knee OA to understand their physical captivity limitations before and after surgery. Additionally, they should be helped by focusing on how to enhance the outcomes of the surgery to reach the maximum activity level improvement.

Conclusions

Based on both subjective and objective assessment tools, Hungarian patients had better PA levels and QOL after TKR. However, the sedentary time among Hungarian patients after surgery is still high and might reflect a reduced efficiency of the surgery. In addition, this study emphasized including objective assessment tools, as they are more sensitive and reliable than subjective assessment tools. Thus, it is important to include objective assessment tools in the evaluation to reduce recall bias and represent more information about the PA level. Hence, long-term follow-up and rehabilitation sessions could be required to reduce the sedentary time and increase the efficiency of the surgery. More research should be done in Hungary to understand the effect of TKR surgery with more participant**s** from different parts of the country.

Disclosures and acknowledgments

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Artificial intelligence (AI) was not used in the creation of the manuscript.

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