

# Activity level and quality of life among Hungarian patients undergoing knee replacement surgery and using ActivPAL: A longitudinal study

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## Research Article

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# Abstract

**Background:** Knee osteoarthritis (OA) is a very common disease in Hungary. Knee replacement surgery is the last-stage intervention for severe cases to reduce pain and improve the quality of life. Nevertheless, there is no information about the activity level of Hungarian before and after the surgery based on objective monitor. Thus, this study aims to evaluate the improvement in activity level and quality of life pre-post surgery among Hungarian patients.

**Methods:** 10 participants ( $70\pm 4$  years,  $30.7\pm 3.4$  kg/m<sup>2</sup>) were included with knee osteoarthritis undergoing total unilateral knee replacement. The activity level was evaluated with the ActivPAL and Short form-36 before and one year after surgery.

**Results:** Out of 10 patients, eight patients were followed up after one year of the surgery. After one year of the surgery, the activity level based on ActivPAL including the number of steps, the time of standing, the time of sitting, and the time of stepping improved between 12.3%-69.4%. The standing time and number of steps improved the most among the patients by 69.4% ( $p=0.041$ ) and 12.3% ( $p=0.051$ ), respectively. Requiring the questionnaire, also the overall score and the pain improved after one year by 58.3% ( $p=0.050$ ) and 26.6% ( $p=0.47$ ), respectively. In contrast, the physical function based on the questionnaire insignificantly improved by up to 17.6% ( $p=0.89$ ).

**Conclusion:** This is the first study in Hungary that used objective and subjective tools. The objective tool showed more improvement in physical activity than the subjective. Nevertheless, the surgery is effective in reducing pain and enhancing the activity level.

## 1. Background

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 osteoarthritis is reported to be 16.54% with 2.9% having advanced osteoarthritis in a group aged (20–67) years [3]. The major symptoms associated with knee OA are pain, low physical activity (PA) level, and disabilities [1–3].

For mild-moderate cases, conservative treatments such as pharmacological treatment, orthotics, physiotherapy sessions could be effective [4, 5]. While total knee replacement (TKR) is the gold-stranded treatment to deal with the late stage of osteoarthritis when the pain is no longer relieved by the conservative treatments [6, 7]. Thus, the expected goals of this surgery are reducing pain and improving the quality of life [6–8].

In Hungary, the pain and PA after the TKR were evaluated only once using the SF-36 questionnaire through a conference study [9]. However, to our knowledge, no study has explored the PA level of Hungarian patients before and after the surgery in terms of the number of steps, sitting time, standing time, stepping time, and upright time using a high validity and reliability accelerometer such as ActivPAL.

This information is important to understand the physical activity level of Hungarian patients with severe knee OA.

Therefore, the aims of this study are (a) understanding the activity level of Hungarian patients with severe knee OA, (b) evaluating the activity level of the Hungarian patients after one year of the TKR surgery, and (c) assessing the associations between the activity level and quality of life (QOL) of the Hungarian patients after the TKR and their demographic characteristics. The variables will be evaluated with both the objective and subjective monitoring tools.

## **2. Methods**

### **2.1 Study design and population**

This study evaluated the quality of life (QOL) and activity level one month before the surgery and one year after the surgery among ten Hungarian patients (six females, four males) with average age of  $70 \pm 4$  years old and  $30.7 \pm 3.4$  kg/m<sup>2</sup> (Table 1). The inclusion criteria were the presence of a clinical and radiological diagnosis of osteoarthritis that required knee replacement surgery. Confirmation of radiological diagnosis was performed by the orthopedic surgeon (Dr. Than Péter) at the orthopedic clinic, the University of Pecs, to ensure that participants need knee replacement injury. Participants were excluded if they has hip and ankle injuries in the last five years; or if they has co-morbidities or medical conditions that affect physical activity such as congestive heart failure. Ethical approval was obtained from the University of Pecs and a consent form was provided from the participates.

### **2.2 Physical activity measurement tools**

The activity level was evaluated with ActivPAL and the short form (SF-36) questionnaire. ActivPAL (PAL Technologies, Glasgow, UK) is a uniaxial accelerometer (20g) that calculates the time spent in sitting, standing, upright, and stepping states and the number of steps per day for up to 14 days contentiously [10–14]. It is recommended to be used with the elderly more than monitors such as ActiGraph as it has higher validity and reliability to detect body movement at different speeds [14, 15]. Before using, the monitor is charged and activated with ActivPAL3™ (version 8.11.9.100).

Moreover, the Hungarian version of the short form (SF-36) was used to assess the 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) [16–18].

### **2.3 Intervention and total knee replacement surgery**

All participants underwent the operation with the medial parapatellar approach that was performed by Dr. Than Péter. Various prosthetics 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 was standardized according to hospital protocols to minimize confounding factors for both in-patient and out-patient periods (for three months).

## **2.4 Data collection procedure**

Before the surgery, all participants were briefed about the study first and signed the consent form. Each participant was asked to complete a Hungarian language SF-36 form before the surgery. Then, they were instructed to wear ActivPAL for seven days most of the time (removed it during shower time or water activities). The instructions were given written and verbally to be sure they will understand the instructions. The activPAL was attached at 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 SF-36 and use the ActivPAL for one week. Same previous instructions were given again to each patient. Then, the participants were asked to return the monitor after one week of usage by post.

## **2.5 Data analysis**

For data from the SF-36 questionnaire, the average ( $\pm$  SD) of physical functioning, physical role, pain, general health, and the overall QOL score were calculated for each participant at all assessment time points. For the data from ActivPAL, the data was extracted from the monitor using the software. Then, the downloaded files were imported into excel. The average ( $\pm$  SD) of sitting time, standing time, stepping time, and the number of steps was 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 data were analyzed by PSS (SPSS Inc., Chicago, IL, USA) using a paired sample test. Significant results could be considered if the significance (2 tailed) value is less than 0.05 [19]. Only eight patients were paired in this study. The data were normally distributed based on the Kolmogorov-Smirnov test [20]. Ethical approval was collected from the university of Pecs.

## **3. Results**

### **3.1 Participants' characteristics**

10 participants initially participated 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 pre-test data because his data were not valid. Thus, ten participants completed the SF-36 form and had valid ActivPAL data before the surgery. After one year of the surgery, eight participants completed the SF-36 form and had valid ActivPAL data (Table 1).

### **3.2 ActivPAL results**

The physical activity level enhanced after one year of the knee replacement surgery based on an objective monitor (Table 2). Before the surgery, patients spent  $3.6 \pm 1.4$  hours per day and  $6.1 \pm 2.8$  hours per day after one year of the surgery (69.4%,  $p=0.041$ ). The stepping time also improved by 37.5% ( $p=0.17$ ) after one year of the surgery. Furthermore, the number of steps enhanced from  $6565 \pm 2697$  to  $7374 \pm 3597$  (12.3%,  $p=0.51$ ). After one year of the surgery, patients spent 2.4 hours per day on sitting activity less than before the surgery.

### 3.3 The SF-36 results

The total QOL score of the patients was  $47.5 \pm 24.8$  before the surgery and improved to  $75.0 \pm 23.1$  after one year of the surgery ( $p=0.05$ ) (Table 2). The pain based on this questionnaire increased from  $40.9 \pm 23.9$  to  $51.8 \pm 25.1$  (26.6%,  $p=0.47$ ). Furthermore, role limitation due to physical health increased by 2.8% ( $p=0.32$ ). In addition, the physical activity and general health after one year of the knee replacement surgery insignificantly improved by 17.6% ( $p=0.89$ ) and 7.4% ( $p=0.74$ ).

## 4. Discussion

This study measured the activity level before and one year after the total knee replacement surgery among Hungarian patients. To our knowledge, this is the first study in Hungary that used a high valid objective accelerometer to understand the physical activity level of Hungarian patients with severe knee OA and their physical activity improvement after one year of the TKR. The patients were asked to use the ActivPAL for six consecutive days. This study found that Hungarian patients with severe knee osteoarthritis spend most of their daily time sitting with average  $18.2 \pm 1.9$  hours per day, and they only spend almost  $1.6 \pm 0.6$  hours per day walking with an average of  $6565 \pm 2697$  steps per day. After one year of the TKR, the Hungarian patients have better physical activity levels and less pain (less pain or a better QOL in general) based on both objective and subjective tools. For instance, the number of steps and the stepping time improved after one year of the surgery by 12.3% and 37.5% measured by ActivPAL. However the sitting time decreased from  $18.2 \pm 1.9$  to  $15.8 \pm 3.2$  hours per day, these changes are still not enough to let the Hungarian patients meet the general physical activity guideline [21].

Few studies evaluated the PA using the same accelerometer with a one-year follow-up [22, 23]. Granat et al., 2020 [22] evaluated the physical activity of 33 patients before and one year after the surgery. This study found that the stepping time and the number of steps improved significantly by 38.77% and 45.6%, respectively, which is similar to our findings. Moreover, Lützner et al., 2014 [23] evaluated the physical activity level of 97 patients before and one year after the knee surgery with ActivPAL. This study found that the number of steps improved by 20.3% (from  $5278 \pm 2999$  to  $6473 \pm 3654$  steps/day) and no changes were seen in sitting and stepping time after one year of 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 four days.

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 58.3% ( $p = 0.041$ ) after one year of the surgery. Similarly, among Greek elderly women, the total score of SF-36 significantly improved from  $29.33 \pm 11.3$  before the surgery to  $62.35 \pm 2.7$  after six months of the surgery [24]. It seems that Hungarian patients have higher physical activity levels than Greek patients before and after the surgery. This finding could be due to the very severe pain the Greek patients had before the surgery as 85% of them had continuous severe pain before the surgery [24]. Other studies used different types of questionnaires. For instance, Granat et al., 2020 [22] found that the physical activity based on the Oxford knee score (OKS) significantly increased by 142% ( $p = 0.00$ ) after one year of the surgery. Also, the OKS score improved after six months of the surgery from 12 points to 42 points [25].

To sum up, the TKR is an effective intervention for Hungarian patients with severe knee osteoarthritis to reduce their pain and enhance their quality of life. However, long follow-up and staying active after the surgery are still necessary in order to get better outcomes. These findings are important for therapists who care for Hungarian patients with severe knee osteoarthritis in order to understand their physical activity limitations before the surgery and how to improve it after the surgery.

## 5. The Limitations

Although the sample size was small, the participants were recruited from a large hospital who came from different places in Hungary. Thus, the results might reflect the general population. Unfortunately, due to the epidemic only few patients were able to visit the hospital and participated in this study. Furthermore, a one-year follow-up could not be sufficient time to assess the effect of the surgery; however, this is the only study in Hungary that evaluated the PA using the ActivPAL after one year of the surgery using an objective monitor. Further studies are recommended with longer follow-up and more participants.

## 6. Conclusion

Based on both subjective and objective assessment tools, Hungarian patients have improved physical activity level and QOL after the TKR. However, the objective assessment tool, ActivPAL, is more sensitive and reliable than the subjective assessment tools. Thus, it is important to include objective assessment tools in evaluation to reduce recall bias and represent more information about the physical activity level. However, the sitting (sedentary) time among Hungarian patients after the surgery is still high and might have reduced the efficiency of the surgery. Hence, long-term follow-up and rehabilitation sessions could be required to reduce the sedentary time and increase the efficiency of the surgery.

## Abbreviations

OA: Osteoarthritis

PA: physical activity

## Declarations

### **Ethics approval and consent to participate:**

Ethics approval and consent to participate: ethical approval was obtained from the University of Pecs research ethics committee (8343/2020). All methods were carried out in accordance with relevant guidelines and regulations.

### **Consent for publication:**

Not applicable.

### **Availability of Data and Materials:**

The datasets generated and/or analysed during the current study are not publicly available due ethical concern and fear of misusing the data but are available from the corresponding author on reasonable request.

### **Competing interests:**

None. The authors, Huda Alfatafta, Mahmoud Alfatafta, David Onchonga, Haitham Khatatbeh, Faten Amer, lu Zhang , Imre Boncz, Péter Than, and Bálint Molics, declare that they have no competing interests (financial and non-financial).

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### **Authors' contributions:**

All authors, Huda Alfatafta, Mahmoud Alfatafta, David Onchonga, Haitham Khatatbeh, Faten Amer, lu Zhang , Imre Boncz, Péter Than, and Bálint Molics, have directly participated in the planning, execution, and analysis of this study. All autehrs have read and approved the final version submitted.

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## Tables

Tabel 1

Demographic data of the participants.

	<b>Total (n=10)</b>
<b>Age (y)</b>	70.6±4.0
<b>Gender</b>	4 males, 6 females
<b>BMI (kg/m<sup>2</sup>)</b>	30.7±4.3
<b>Smoking</b>	1 (1 female)
<b>Heart problems</b>	4 ( 2 males, 2 females)
<b>Diabetes</b>	3 (1 male, 2 females)
<b>Hypertension</b>	8( 3 males, 5 females)

Table 2

The average of the activity level before and one year after the total knee replcement suregry. The number of the paired sample is eight.

	Pre-surgery	One year post-surgery	Significant (P value)	95% Confidence interval for differences (IC)	
				Low	High
<b>SF-36 score (pre-surgery n=10, post-surgery n=8)</b>					
<b>Overall score</b>	47.5±24.8	75.0±23.1	0.050	-59.9	-0.19
<b>Physical functioning</b>	52.0±22.7	61.2±21.5	0.89	-50.9	57.2
<b>Role limitations due to physical health</b>	42.5±37.3	43.7±7.4	0.32	-23.3	12.2
<b>Pain</b>	40.9±23.9	51.8±25.1	0.47	-27.0	13.7
<b>General health</b>	52.5±13.1	56.2±20.6	0.704	-26.1	18.6
<b>ActivPAL data (pre-surgery n=10, post-surgery n=8)</b>					
<b>Time of sitting (hour)</b>	18.2±1.9	15.8±3.2	0.073	-0.24	4.1
<b>Time of standing (hour)</b>	3.6±1.4	6.1±2.8	0.041	-4.22	-0.11
<b>Time of stepping (hour)</b>	1.6±0.6	2.2±0.9	0.17	-1.19	0.26
<b>Number of steps (number)</b>	6565±2697	7374±3597	0.51	-2153.52	1185.52