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RESEARCH ARTICLE

Determination of the effect of preoperative knee joint function on postoperative quality of life in patients with total knee arthroplasty

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Abstract

Primary total knee arthroplasty (TKA) is one of the most successful procedures for end-stage knee osteoarthritis. To determine the effect of preoperative knee joint function on postoperative quality of life in patients undergoing primary TKA. This descriptive cross-sectional study was conducted with a total of 208 patients in the orthopedics and traumatology clinic. Data were gathered with a personal information form, the Oxford Knee Score (OKS), and the EQ-5D-5L Quality Of Life Scale in the preoperative period, at postoperative 6th week, and at postoperative 3rd month. The data were analyzed using descriptive statistics, one-way analysis of variance (ANOVA), correlation analysis, and simple linear regression analysis. The mean age of the patients was 65.65 ± 7.01 years. Most patients (86.1%) were women, and 51.4% underwent left TKA. OKS scores indicated poor knee function preoperatively and gradually increased at postoperative 6th week and 3rd month. Preoperative OKS was a significant predictor of postoperative knee joint function and quality of life. This study shows that preoperative knee joint function significantly affects postoperative knee joint function and quality of life. These results demonstrate the importance of the surgery timing and suggest that performing surgery earlier in functional decline may be associated with a better outcome.

KEYWORDS

knee joint function, quality of life, total knee arthroplasty

1 | INTRODUCTION

Knee osteoarthritis (OA) is a chronic joint disease that adversely affects older adults' quality; of life (QoL) and functional capacity.[1] In cases where conservative treatment methods fail to resolve joint problems, the most effective treatment is arthroplasty. Total knee arthroplasty (TKA) significantly improves pain symptoms, joint functionality, functional capacity, and QoL.[2,3] Despite these positive results, some patients report difficulty performing specific functional tasks after surgery.[4] The variability in surgical outcomes required the investigation of preoperative characteristics that predict postoperative patient outcomes.[5]

The timing of surgery is determined by crucial factors such as severe pain, diminished functional capacity, physical examination results,

radiological findings, and the lack of response to conservative treatments.[6] However, there is no generally accepted protocol for deciding when TKA is performed. TKA is generally recommended when pain persists despite 6 months of nonoperative intervention and there is radiological evidence of end-stage degenerative knee joint disease.[7] Additionally, the patient's preference is one of the most important factors in the timing of surgery. Various circumstances such as sociocultural barriers and fear of surgery and postoperative disability can lead patients with severe knee OA to postpone surgery.[6,8] This delay permits the progression of OA, leading to considerable impairment in preoperative functional capacity, consequently influencing surgical outcomes. A deteriorated preoperative functional status has shown correlations with prolonged hospital stays, increased costs, and diminished patient outcomes.[5,9] As the number of joint arthroplasties performed worldwide increases, it becomes even more important to preoperatively identify individuals who are predicted to have poor postoperative outcomes.

QoL is a broad concept that includes the individual's responses to the disease's physical, mental, and social effects.[10] TKA is an effective surgical intervention that significantly improves QoL.[10,11] In the literature, studies examining QoL after TKA have been primarily descriptive and investigated factors affecting QoL such as socio-demographic characteristics, comorbidities, surgical techniques, and pain.[2,3,5,12] Few studies have examined the effect of preoperative functional status on postoperative QoL.[13,14] The number of primary TKA procedures is projected to increase by 85% (1.26 million) by 2030.[15] Therefore, investigating the effect of knee joint function before TKA on postoperative QoL will provide vital information for making timely surgery decisions and addressing both patient- and health system-related factors that delay surgery. This study aimed to determine the relationship between preoperative knee joint function and postoperative QoL in patients undergoing primary TKA.

2 | METHODS

2.1 | Study design

This cross-sectional and descriptive study was conducted to determine the correlation between preoperative knee joint function and postoperative QoL in patients undergoing primary TKA.

2.2 | Study setting and sampling

The study population consisted of individuals who presented to Usak Training and Research Hospital Orthopedics and Traumatology Outpatient Clinic with complaints of knee OA between August 2022 and January 2023 and were scheduled for TKA surgery. The sample size was determined as 208 patients based on the number of independent variables, an effect size of 0.15, significance value of 0.05, and 90% power using an online calculation tool (https://www.danielsoper.com/statcalc/calculator.aspx?id=1). Patients undergoing unilateral primary TKA who volunteered to participate in the study and were able to provide written informed consent were included. Exclusion criteria were active malignancy, psychiatric problems (Alzheimer's disease and dementia), and undergoing revision or bilateral TKA. Participants could withdraw from the study at any time without stating a reason. The final number of participants was 229, while 208 participants completed the follow-up at the 3 months postoperatively and the power reached 0.90 (Figure 1). The participants didn't receive physiotherapy such as supervised therapy or a standard home program.

2.3 | Data collection procedure and measurement tools

Data were collected by face-to-face interviews in the clinic preoperative period, and by telephone interviews at postoperative 6th week, and at postoperative 3rd month with Personal Information Form, Oxford Knee Score and EQ-5D-5L Quality of Life Questionnaire.

2.3.1 | Personal information form

This form was prepared by the researchers. The 14 items in the form included sociodemographic and medical characteristics and questions about the patient's height, weight, chronic comorbidities, number of drugs used, type of anesthesia, TKA side, smoking, and alcohol use.

2.3.2 | Oxford knee score

The OKS was developed by Dawson et al. in 1998.[16] The Turkish validity and reliability study was performed by Tuğay et al. in 2016 (Cronbach's α: 0.90).[17] The scale assesses pain and functional status and is used to evaluate the effectiveness of treatment and the patient's knee-related QoL. Each of the 12 items in the scale is scored between 0 (most pain/difficulty) and 4 (least pain/difficulty), for a total score ranging from 0 to 48 points. In this scoring, a high score is associated with high functional capacity of the knee.[16]

2.3.3 | EQ-5D-5L quality of life questionnaire

The EQ-5D-5L five-dimensional and five-level general QoL scale was introduced by the EuroQol group in 2009 (Cronbach's α: 0.86) and consists of two parts. The first part is that day's health profile, described in five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension has five response options: no problem, slight problem, moderate problems, severe problems, and extreme problems. The second part consists of the visual analog scale (VAS). In this section, individuals rate their current health status between 0 and 100 on a thermometer-like

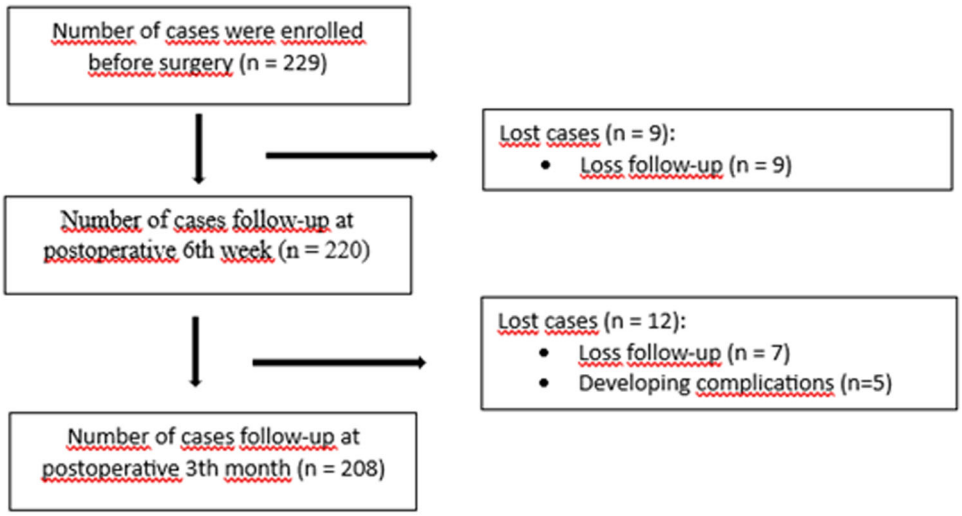

FIGURE 1 Number of cases included and reasons for loss.

vertical scale, with higher scores corresponding to greater perceived health. This score is accepted as the QoL score. The questionnaire has been translated into 171 languages by the EuroQol group, and the Turkish version was used in this study.[18]

2.4 | Ethical considerations

All study procedures were approved by Usak University Clinical Research Ethics Committee (Approval Date: 27.07.2022; Approval Number: 03) were conducted in accordance with the Helsinki Declaration. Permission to conduct the study was also obtained from the hospital (No. 45786011-774). Moreover, verbal and written informed consent were obtained from each participant.

2.5 | Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics version 23.0 (released 2016; Armonk, NY: IBM Corp.). Descriptive data were evaluated with number, percentage, mean, and standard deviation. Skewness and kurtosis values (+2 and −2) were used to assess the normality of data distributions.[19] One-way repeated measures analysis of variance (ANOVA) with post-hoc Bonferroni test was used to evaluate differences in OKS scores over time (3 time points: preoperative and postoperative 6th weeks and 3rd months). Paired-samples *t*-test was used to determine differences in EQ-5D-5L scores over time (2 time points: postoperative 6th week and 3rd month). The effect size (Cohen's d) for the t-test was calculated (G*power 3.1.9.2) and the partial eta-square value (SPSS 22.0) was calculated to analyze variance. Pearson and Spearman correlation analyses were used to evaluate the relationships between variables. Simple linear regression analysis was used to determine the effect of preoperative knee joint function on postoperative QoL and knee joint function. The significance level was accepted as $p < 0.05$.

3 | RESULTS

This descriptive, cross-sectional study conducted with 208 patients undergoing TKA. The patients' mean age was 65.65 ± 7.01 years and the mean body mass index was 32.05 ± 5.25 kg/m^2. Of the patients, 86.1% were women, 69.70% had primary education or less, 78.8% were married, and 58.2% lived with their spouse. Nearly all patients (93.3%) received spinal anesthesia during surgery, and 51.4% had left TKA. The patients used a mean of 3.38 ± 2.41 drugs daily and 84.6% had a chronic disease and were constantly using medication. (Table 1). The most common comorbidities were hypertension and diabetes.

Although it is not presented in tabular form, it was found that the ODS score, quality of life (EQ-5D-5L) index values, and general health status (EQ VAS) mean scores of the patients were significantly lower in women in the preoperative period, as well as at the 6th week and 3rd month postoperatively. However, there is no significant difference between the average scores concerning smoking, continuous medication use, type of anesthesia, and the presence of chronic disease.

The patients' mean preoperative OKS score indicated poor joint function (9.95 ± 6.85). OKS scores increased to fair (24.75 ± 9.75) at postoperative 6th week and good (34.50 ± 9.87) at postoperative 3rd month. The mean OKS score at postoperative 3rd month was significantly improved compared to both the preoperative and postoperative 6th week values, and was also significantly improved at postoperative 6th week compared to the preoperative period ($p < 0.05$) (Table 2).

The mean EQ-5D-5L index values of the patients were 0.55 ± 0.27 at postoperative 6th week and 0.76 ± 0.25 at postoperative 3rd month. The mean general health status (EQ-5D-5L-VAS) score was 68.47 ± 20.11 at postoperative 6th week and

TABLE 1 Sociodemographic characteristics (n = 208).

	min-max	X̄ ± SS
Age	48–84	65.65 ± 7.01
BMI[a]	20.2–51.1	32.05 ± 5.25
Number of drugs	0–12	3.38 ± 2.40
	n	**%**
Sex		
Female	179	86.1
Male	29	13.9
Marital Status		
Married	164	78.8
Single	44	21.2
Education Level		
illiterate	41	19.7
Literate/primary school	145	69.7
High school	17	8.1
University	5	2.4
Occupational Status		
Yes	8	3.8
No	200	96.2
Where Person Lives		
Home	208	100
Person Living With		
Family	191	91.8
Alone	17	8.2
Smoking Status		
Yes	3	1.4
No	205	98.6
Alcohol Status		
Yes	0	0
No	208	100
Comorbidity		
Yes	176	84.6
No	32	15.4
Continuous Medication		
Yes	176	84.6
No	32	15.4
Type of Anesthesia		
Spinal	194	93.3
General	14	6.7
Operated Knee		
Right knee	101	48.6
Left knee	107	51.4

[a]BMI, Body Mass Index; X̄, Mean; SS, Standard deviation.

TABLE 2 Comparison of preoperative, postoperative 6th week and postoperative 3rd month Oxford knee score (n = 208).

	Preoperative (X̄ ± SS)	Postoperative 6th Week (X̄ ± SS)	Postoperative 3rd Month (X̄ ± SS)	η^2/Power	F	p	Difference
OKS	9.95 ± 6.854 (worst)	24.75 ± 9.750 (middle)	34.50 ± 9.866 (good)	0.794/1.00	795.888	0.000	1 < 2 < 3
The number of item	12	12	12				
Total score (Min-Max)	0–48	0–48	0–48				
Participants' score (Min-Max)	0–30	0–48	4–48				

Note: F: Analysis of variance in repeated measures (sd: 1.78) Post hoc analysis: Bonferroni test. η^2: Partial eta squared, effect size for analysis of variance (According to partial eta squared, 0.1 is considered as low effect, 0.3 as medium effect, 0.5 and above is high effect level).

Abbreviation: OKS, Oxford Knee Score.

TABLE 3 Comparison and sub-scales of preoperative, postoperative 6th week and postoperative 3rd month EQ-5D-5L score ($n = 208$).

EQ-5D-5L	Postoperative 6th Week $\bar{X} \pm SS$ (min-max)	Postoperative 3rd Month $\bar{X} \pm SS$ (min-max)	t[a]	p
Index value (0–1)	0.55 ± 0.27 (−0,59 −1)	0.76 ± 0.25 (−0,28 −1)	−12.748	0.000
VAS score (0–100)	68.47 ± 20.11 (0–100)	82.72 ± 16.19 (30–100)	−13.888	0.000

Sub-scales of EQ-5D-5L	Postoperative 6th Week $\bar{X} \pm SS$ (min-max)	Postoperative 3rd Month $\bar{X} \pm SS$ (min-max)
Mobility	2.39 ± 0.93 (1–5)	1.69 ± 0.85 (1–4)
Self-care	2.30 ± 0.93 (1–5)	1.56 ± 0.85 (1–4)
Usual activities	2.65 ± 1.02 (1–5)	1.87 ± 1.01 (1–5)
Pain/discomfort	2.49 ± 0.92 (1–5)	1.69 ± 0.86 (1–5)
Anxiety/depression	1.77 ± 1.06 (1–5)	1.40 ± 0.94 (1–5)

[a]Paired sample *t*-test (sd:207).

TABLE 4 The correlation analysis of preoperative knee joint function, postoperative quality of life and OKS ($n = 208$).

	EQ-5D-5L Index Value (0–1)[b]		EQ-5D-5L VAS score (0–100)[a]		Postoperative OKS[a]	
	6th Week	3rd Month	6th Week	3rd Month	6th Week	3rd Month
Preoperative OKS						
r	0.251	0.246	0.227	0.139	0.505	0.284
p	**0.000**	**0.000**	**0.001**	**0.045**	**0.000**	**0.000**

Abbreviation: OKS, Oxford Knee Score.

[a]Pearson coefficients.

[b]Spearman coefficients.

82.72 ± 16.19 at postoperative 3rd month (Table 3). Both of these values were noticeably higher at postoperative 3rd month than 6th week ($p < 0.05$).

There were positive correlations between preoperative OKS score and postoperative EQ-5D-5L general health score index values at 6th week (r = 0.251, $p < 0.001$) and 3rd month (r = 0.246, $p < 0.001$). There were also weaker positive correlations between preoperative OKS and postoperative EQ-5D-5L-VAS scores at 6th week (r = 0.227; $p < 0.05$) and 3rd months (r = 0.139; $p < 0.05$). In addition, preoperative OKS scores were correlated with OKS scores at postoperative 6th week (r = 0.505; $p < 0.001$) and 3rd month (r = 0.284; $p < 0.001$) (Table 4).

The results of simple linear regression analysis indicated that preoperative knee joint function was a significant predictor of QoL and knee joint function at 6th week and 3rd month postoperatively ($p < 0.05$) (Table 5).

4 | DISCUSSION

This study investigated the effect of preoperative knee joint function on postoperative QoL in 208 patients who underwent primary TKA. Our findings revealed that these patients exhibited impaired knee joint function before surgery. In different studies in the literature, preoperative knee joint function was reported to be poor[20–22] or fair.[23,24] TKA is considered the most common treatment for end-stage knee OA unresponsive to conservative treatments.[7] Therefore, our findings of poor preoperative knee joint function are expected and consistent with the literature.

TKA is an effective surgical procedure that reduces pain and improves mobility, functional status, and knee joint function in patients with knee OA.[25] In the literature, it is reported that 1 year after TKA, patients had significantly improved knee joint function and more than 90% were satisfied with the surgical outcomes.[12,26] In addition, as surgical techniques and joint prosthesis technology advances and the quality of care improves, the postoperative recovery period is expected to become shorter.[27–29] This has increased the importance of joint function recovery in the early postoperative period. The present study demonstrated that knee joint function improved significantly from poor preoperatively to fair at postoperative 6th week and good at 3rd month. Prospective studies by Chang et al. ($n = 101$) and Miao and Lin ($n = 105$) also showed that knee joint function was improved 6 weeks after TKA.[21,23] In another prospective study, Maruyama et al. followed 121 patients for 1 year postoperatively and revealed that 6-min walk test distance and stair climbing and descending ability were improved at 3 months after TKA compared to the preoperative period, and knee range of motion improved after the third month.[26] In a qualitative study by Lin et al. with 20 participants who underwent TKA, most patients had less pain and improved range of motion 6–8 weeks after surgery.[30]

The OKS is an international tool widely used to measure preoperative functional limitations due to knee OA and to evaluate postoperative recovery.[24,31] The increase in the postoperative OKS score can be interpreted as an indicator of patient satisfaction.[12,22] In this study, we observed that better preoperative knee function was associated with better postoperative knee function. The patients' preoperative knee joint function had a significant effect on their knee joint function at 6th week and 3rd month postoperatively. This is relevant to the timing of arthroplasty, which has been shown to impact patient outcomes and costs.[5,14] In a prospective study in which 127 patients with unilateral total hip and knee arthroplasty were followed for 3 years, the patients with lower preoperative physical function had worse outcomes than those with better

TABLE 5 The regression analysis of preoperative knee joint function, postoperative quality of life and OKS ($n = 208$).

	B	Standard Error	Standardize β	t	P	R	R Square	F	p
Postoperative 6th Week Index Value									
Constant	0.449	0.033		12.625	0.000	0.265	0.070	15.601	0.000
Preoperative OKS	0.161	0.034	0.310	4.776	0.000				
Postoperative 6th Week VAS score									
Constant	61.848	2.405		25.717	0.000	0.227	0.051	11.148	0.001
Preoperative OKS	0.665	0.199	0.227	3.339	0.001				
Postoperative 3rd Month Index Value									
Constant	0.691	0.031		22.212	0.000	0.191	0.036	7.795	0.006
Preoperative OKS	0.007	0.003	0.191	2.792	0.006				
Postoperative 3rd Month VAS score									
Constant	79.442	1.969		40.357	0.000	0.139	0.019	4.084	0.045
Preoperative OKS	0.329	0.163	0.139	2.021	0.045				
Postoperative 6th Week OKS									
Constant	17.596	1.033		17.037	0.000	0.505	0.255	70.530	0.000
Preoperative OKS	0.718	0.086	0.505	8.398	0.000				
Postoperative 3rd Month OKS									
Constant	30.422	1.161		26.206	0.000	0.284	0.081	18.127	0.000
Preoperative OKS	0.409	0.096	0.284	4.258	0.000				

preoperative physical function.[5] In another prospective study in which 138 TKA patients were followed for 6 months postoperatively, it was determined that preoperative status was significantly associated with postoperative status in terms of functional limitation.[32] In a systematic review by Lungu et al. examining determinants of short- to medium-term pain and functional outcomes after TKA, worse preoperative knee pain or disability was found to be a clinically significant determinant.[9] Furthermore, a retrospective study of 5857 patients who underwent primary TKA showed that preoperative OKS score was an independent predictor of achieving a postoperative ceiling score following TKA.[33] These results provide information that can assist in determining the most appropriate timing of surgery based on preoperative status.

In the present study, the patients reported significantly better QoL at postoperative 3rd month than at 6th week. TKA is known to be associated with improvements in knee function and improved QoL.[2,3,10] The fastest functional improvements occur in the first year after TKA,[34] and the most common outcomes of surgery are reduced pain, improved lower extremity function, and a return to a physically active life.[21,32] These results explain the notable increase in patients' QoL.

Additionally, our findings indicate a positive correlation between preoperative knee joint function and postoperative QoL, with preoperative OKS scores emerging as a significant predictor of postoperative QoL in regression analysis. A cohort study by Gwynne-Jones et al. including 520 patients who underwent TKA stated that significant improvement in QoL at 1 year after TKA, and that patients with poorer preoperative OKS scores had lower QoL at 1 year compared to those with higher preoperative scores.[13] In another cohort study ($n = 484$) conducted by Eibich et al. using data from the UK National Database, it was determined that TKA patients with a high preoperative OKS score also had a high postoperative QoL. Additionally, it has been demonstrated that costs are moderately higher and the recovery process may be longer for patients with low preoperative scores. It has been shown that the majority of patients who are potentially suitable candidates for total knee replacement do not undergo the procedure within 2–4 years, and nearly half of these patients exhibit severe symptoms.[35] Performing total knee replacement too early may expose the patient to the risks of a major operation with little or no benefit. Conversely, waiting too long to undergo surgery may result in limitations in physical activity, potentially increasing the risk of additional disability and chronic disease, thereby negatively impacting surgical outcomes.[36] There is limited knowledge about the timing of this surgery. Making an evidence-based decision, considering the risks and benefits of both options (performing the surgery too early or too late), would minimize adverse outcomes after surgery.

5 | CONCLUSION

In conclusion, we revealed that patients undergoing TKA had poor preoperative knee joint function and their OKS scores increased significantly starting from postoperative 6th week. Better

preoperative knee joint function was associated with better postoperative knee joint function and QoL. These findings underscore that preoperative knee joint function affects the functional status and QoL reported by patients after surgery and highlight the importance of surgery timing. Performing surgery earlier the course of functional decline may be associated with a better outcome.

5.1 | Strengths and limitations

The current study has several limitations. Firstly, the data for this study were collected exclusively from one center, which may limit the generalizability of the findings. Secondly, the follow-up period for patients in the postoperative period was limited to 3 months. Longer-term follow-ups could provide a more comprehensive understanding of patients' functional capacity and their quality of life over time. Despite these limitations, our results indicate a correlation between preoperative knee joint function and postoperative quality of life among patients undergoing unilateral primary TKA. Conducting long-term follow-up studies could be advantageous for future studies.

AUTHOR CONTRIBUTIONS

Cigdem Kaya: Research design; acquisition; analysis; data interpretation; drafting the paper. **Çiğdem Canbolat Seyman**: Research design; acquisition; analysis; data interpretation; revising the paper critically. **Yılmaz Kaya**: Research design; data interpretation; revising the paper critically. All authors have read and approved the final submitted manuscript.

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