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Influence of increased pain sensitivity on patient-reported outcomes following total knee arthroplasty

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Abstract

Purpose The purpose of this study was to discover whether increased pain sensitivity was associated with postoperative pain and patient-reported outcome measures (PROMs) after total knee arthroplasty (TKA).

Methods Pain sensitivity was evaluated preoperatively using a pain sensitivity questionnaire (PSQ). Resting, walking, nighttime, and average pain visual analog scale (VAS) were measured before surgery and 6 weeks, 3 months, 6 months, and 1 year after surgery. PROMs were also evaluated based on the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score and patient satisfaction. The association between pain VAS average score, WOMAC total score, and PSQ score (minor, moderate, and total score) was assessed at each stage.

Results There were 59 patients with a high PSQ score (≥ 5.2) and 53 with a low PSQ score (< 5.2). Up to 1 year postoperatively, the group with high PSQ scores had higher resting, walking, nighttime, and average pain VAS scores than the group with low scores (all $p < 0.05$). Worse preoperative WOMAC pain, function, and total scores continued until 1 year after surgery in the high-scoring PSQ group (all $p < 0.05$). The group with low PSQ scores was more satisfied with surgery than the group with high scores ($p = 0.027$). There was a positive correlation between preoperative PSQ score and pain VAS average score at all time points (all $p < 0.05$). A relationship between PSQ score and WOMAC total score was also observed (all $p < 0.05$).

Conclusion Increased pain sensitivity is a factor related to higher postoperative pain levels and inferior PROMs in patients undergoing primary TKA.

Level of evidence Case-controlled study, III.

Keywords Pain threshold · Surveys and questionnaires · Pain · Patient-reported outcome measures · Patient satisfaction · Total knee arthroplasty

Introduction

Knee osteoarthritis (OA) is the most common joint arthritis and is characterized by joint degeneration and chronic disabling pain [26]. Knee OA begins with cartilage and bone damage, which gradually increases, resulting in severe pain and clinical symptoms [31]. Despite the removal of the nociceptive input of the damaged joint by total knee arthroplasty (TKA), there are cases where the pain pattern continues [22].

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Certain subgroups of patients undergoing TKA for OA do not respond well to arthroplasty [37]. Pain sensitivity is high in many chronic pain disorders such as chronic tension-type headache [3], fibromyalgia [7], temporomandibular dysfunction [12], and chronic low back pain [11]. The association of increased pain sensitivity and chronic pain in various musculoskeletal disorders is well established [3, 7, 11, 12]. Although end-stage knee OA is a representative disease in chronic musculoskeletal pain disorders [27], there are insufficient studies on the relationship between pain sensitivity and postoperative pain and Patient reported outcome measures (PROMs) after TKA [39].

The purpose of this study was to investigate whether increased pain sensitivity was associated with postoperative pain and PROMs after TKA. It was hypothesized that patients with higher pain sensitivity would have more severe pain levels after TKA and inferior postoperative PROMs.

Materials and methods

This study was approved by the institutional review board of our hospital. Between May 2018 and June 2019, a total of 131 primary TKAs were performed in 131 patients at our institution by a single surgeon. Inclusion criteria were patients who underwent unilateral primary TKA for primary OA without a diagnosis of osteonecrosis, inflammatory arthritis, traumatic OA, flexion contracture greater than 20° or previous infection. Patients were screened for comorbidities and excluded if they had an American Society of Anesthesiologists (ASA) physical status III or higher, a history of drug or alcohol abuse, opioid medication use within 1 month before surgery, a history of psychiatric disorders or peripheral vascular disease, or a concurrent serious medical condition such as cancer, spinal cord injury, multiple sclerosis or another neurological pain disorder. In addition, patients with chronic pain disorders such as chronic tension-type headache [3], fibromyalgia [24], temporomandibular dysfunction [29], restless leg syndrome [13], chronic fatigue syndrome [32], or chronic low back pain [11], which might affect pain sensitivity, were also excluded. Finally, 112 patients with primary unilateral TKAs were enrolled in this study (Fig. 1).

The pain sensitivity questionnaire (PSQ) consists of 17-item questions developed to evaluate the numeric rating scale of imagined painful situations in daily life (Table 1) [36]. Patients are asked to rate how much pain they experience in a particular situation on a scale from 0 to 10. Fourteen of 17 items are related to situations considered to be painful by most healthy individuals. The PSQ consists of moderate and minor subscales. PSQ-moderate represents 7 items of moderately painful situations and PSQ-minor represents 7 items of slightly painful situations. The total PSQ is measured as a mean of all items excluding the 3 non-painful items [4, 36]. There has been no validated cut-off value to divide high and low PSQ groups in patients with TKA. Therefore, we referred to the results of previous study, and used a PSQ score of 5.2 points as a threshold for dividing high and low PSQ score groups [4]. The patients filled out the PSQ forms when admitted the day before surgery.

All surgeries were performed by a single surgeon (MSK) through a subvastus approach under general anesthesia. All patients received the same posterior-stabilized TKA implant (LOSPA, Corentec, Seoul, Korea). Multimodal oral analgesic drugs, 200 mg celecoxib and 150 mg pregabalin, were given once for preemptive analgesia two hours before operation according to the critical pathway used by our hospital. For additional pain-relieving procedures, a combination of ropivacaine, morphine, and ketorolac was used for periarticular injection [23, 25]. Intravenous patient-controlled analgesia (PCA) was applied and success was confirmed by an experienced anesthesiologist. PCA was programmed to deliver 1 mL of a 100-mL solution containing 2000 μg fentanyl for all patients. Intravenous PCA was typically stopped on the fourth postoperative day. The patients received 10 mg oxycodone, 200 mg celecoxib, 37.5 mg tramadol, and 650 mg acetaminophen every 12 h after diet. An intramuscular injection of tridol (50 mg) was used pro re nata for acute pain relief when a patient-reported pain was greater than level 6 on a 0–10-point visual analog score (VAS). All patients underwent the same rehabilitation program. Quadriceps strengthening and knee range of motion (ROM) exercises were initiated immediately after surgery. From the first day after surgery, ambulation was initiated using a walker.

Patient demographics including age, gender, body mass index (BMI), ASA physical status, and physical comorbidities were evaluated and compared between the two groups. The surgery was evaluated using the hip–knee–ankle (HKA) angle, and −3° to +3° was used as the standard for accurate lower limb alignment. Cases beyond this range were considered outliers [38]. Two independent investigators evaluated all radiographic measurements twice at 2-week intervals to reduce bias. The average value of the measurements of the two testers was used. The intra-observer and inter-observer reliabilities of the measurement were assessed using the intraclass correlation coefficient, indicating good reliability of 0.8 or higher.

PCA consumption during the 72 h following TKA, and the use of analgesics during the hospitalization period and the 1-year follow-up period were investigated. Knee pain was measured before surgery and 6 weeks, 3, 6 months, and 1 year after surgery using an 11-point VAS (0 = no pain, 10 = worst possible pain). Pain was evaluated using rest, walking, night and 24-h average pain VAS. PROMs were assessed using Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score and postoperative satisfaction. WOMAC was also measured and

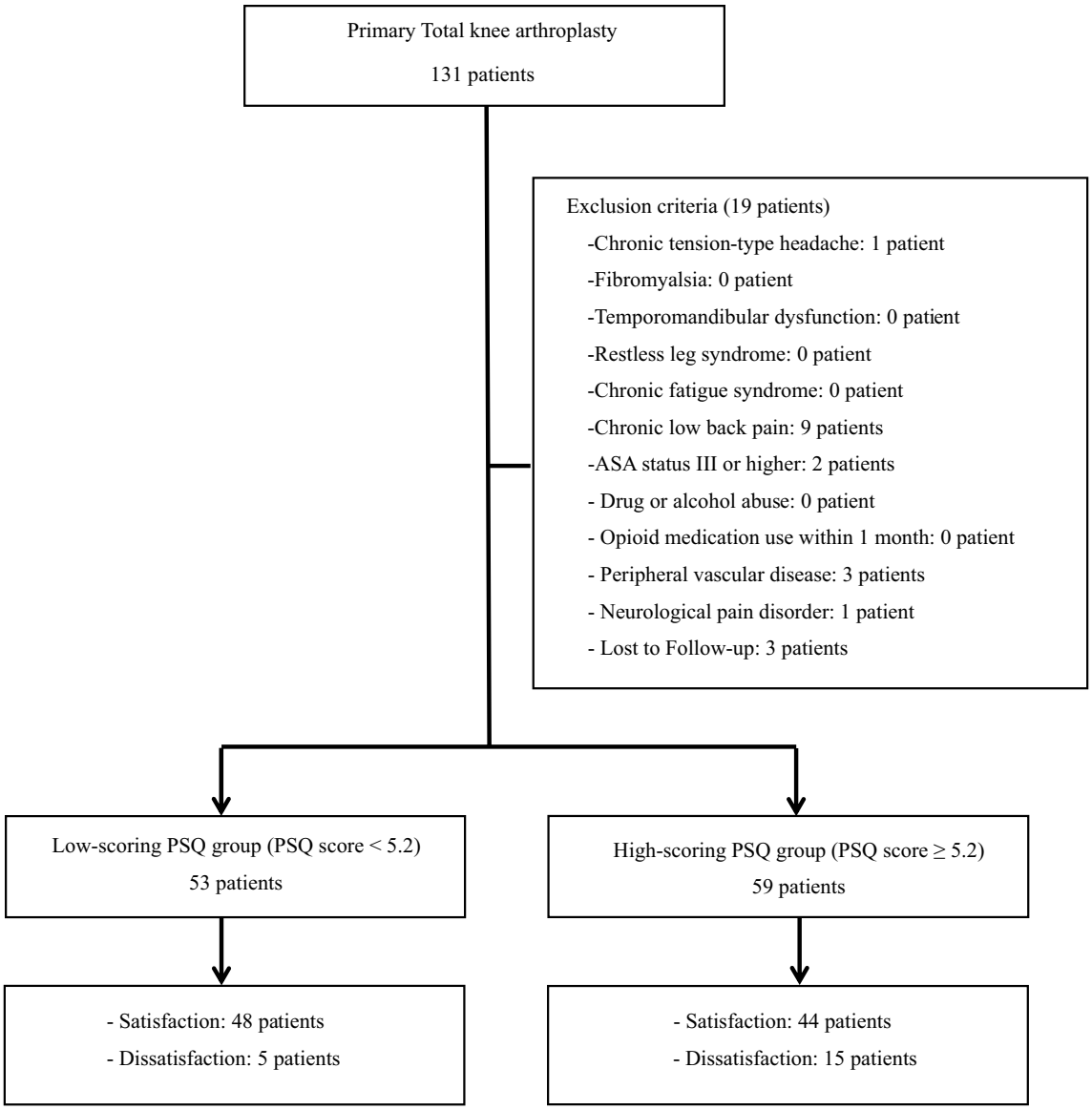

Fig. 1 Participant flow diagram. *PSQ* Pain Sensitivity Questionnaire

compared preoperatively and postoperatively (6 weeks, 3, 6 months, and 1 year). Patient satisfaction was evaluated once at 1 year postoperative using a 5-point Likert scale [20]: 0 was very dissatisfied, 1 was dissatisfied, 2 was neutral, 3 was satisfied, and 4 was very satisfied. Those that scored 3 and 4 were set as the satisfied group, and those that scored 0, 1, and 2 were set as the dissatisfied group [20]. The association between pain VAS score, WOMAC score, and PSQ score (minor, moderate, and total score) from preoperative to 1 year postoperative was also assessed. Patients were provided with questionnaires for PSQ, VAS, WOMAC, and satisfaction so that patients could fill out their own.

Statistics

Data were compared between patients with a low (PSQ score < 5.2) and high (PSQ score ≥ 5.2) PSQ score [4]. The Shapiro–Wilk test was used to determine the normality of the data. The *t* test was used for continuous variables and the chi-square test or Fisher's exact test was used for categorical data for two independent samples, where appropriate. Categorical variables were reported as frequency and percentage, and continuous variables were reported as mean and standard deviation. Spearman correlation analysis was used to evaluate the association between pain

Table 1 Pain Sensitivity Questionnaire

Pain sensitivity minor	3. Imagine your muscles are slightly sore as the result of physical activity
	6. Imagine you have mild sunburn on your shoulders
	7. Imagine you grazed your knee falling off your bicycle
	10. Imagine you have a minor cut on your finger and inadvertently get lemon juice in the wound
	11. Imagine you prick your fingertip on the thorn of a rose
	12. Imagine you stick your bare hands in the snow for a couple of minutes or bring your hands in contact with snow for some time, for example, while making snowballs
	14. Imagine you shake hands with someone who has a very strong grip
Pain sensitivity moderate	1. Imagine you bump your shin badly on a hard edge, for example, on the edge of a glass coffee table
	2. Imagine you burn your tongue on a very hot drink
	4. Imagine you trap your finger in a drawer
	8. Imagine you accidentally bite your tongue or cheek badly while eating
	15. Imagine you pick up a hot pot by inadvertently grabbing its equally hot handles
	16. Imagine you are wearing sandals and someone with heavy boots steps on your foot
	17. Imagine you bump your elbow on the edge of a table ("funny bone")

VAS average score, WOMAC total score, and PSQ score (minor, moderate, and total score) at each stage from preoperative to 1 year postoperative. When a value after the decimal point was presented in the results, it was rounded off to the two decimal places and presented to the one decimal place. All statistical analyses were performed using SPSS ver. 21.0 program (SPSS Inc., Chicago, IL, USA). A p value < 0.05 was considered statistically significant.

Results

Among the 112 patients who underwent TKA, 59 patients had a high PSQ score and 53 had a low PSQ score. The mean PSQ total score was 3.9 (range 2.1–5.1) in the group with low PSQ scores and 6.3 (range 5.3–10.0) in the group with high PSQ scores ($p < 0.001$). The PSQ minor and moderate scores were also significantly higher in the PSQ group with high scores than in the PSQ group with low scores (PSQ minor score: 5.1 [range 3.1–10.0] vs 2.8 [range 1.1–5.0], PSQ moderate score: 7.5 [range 5.7–10.0] vs 4.9 [2.4–7.7], respectively, all $p < 0.001$). Table 2 shows a comparison of preoperative demographics with no significant differences between the two groups. PCA consumption was 47.7 mL in the low PSQ group, significantly lower than observed in the high PSQ group (60.2 mL; $p < 0.05$). Two patients in each group discontinued PCA due to nausea and dizziness ($p > 0.05$). During hospitalization, intramuscular tridol consumption was 3.5 times in the low PSQ group and 6.3 times in the high PSQ group, with a significant difference between the two groups ($p < 0.05$).

Patients in the high PSQ score group reported significantly higher pain levels for all pain VAS items from preoperative to 1 year postoperative compared to the group with a low PSQ score (all $p < 0.05$) (Table 3). The high PSQ score group had significantly higher pain, function, and total WOMAC scores from preoperative to 1 year after surgery compared to the group with lower PSQ scores (all $p < 0.05$) (Fig. 2). Forty-four patients (74.6%) in the high PSQ group were satisfied, and 48 (90.6%) in the low PSQ group were satisfied ($p = 0.027$).

The PSQ minor and PSQ total scores showed a similar relationship with pain severity from preoperative to 1 year after surgery, but PSQ total scores showed a slightly higher correlation (all $p < 0.05$). In addition, PSQ moderate score was also associated with pain severity up to 1 year after surgery (all $p < 0.05$). A relationship between PSQ score and WOMAC total score was similarly observed (all $p < 0.05$) (Table 4).

Discussion

The most important finding of this study was that preoperative pain sensitivity was related to higher pain levels and inferior PROMs in patients undergoing TKA. In the present study, patients with a PSQ score greater than 5.2 points had significantly higher pain severity from preoperative to 1 year postoperative compared to patients with a PSQ score of less than 5.2 points.

The pain levels associated with TKA are severe in the acute period after surgery, and some patients complain of persistent pain after surgery [5, 6]. Therefore, there has been a lot of interest and research on pain control after TKA [15], as well as active research on the factors that cause different pain levels [6, 28]. Even though the degree of pain perception is strongly associated with patient pain, [9, 36] there have been insufficient studies on the relationship between pain sensitivity and pain levels before and after TKA in patients with knee OA [39].

Table 2 Comparison of demographic characteristics and surgical factors

	Low PSQ score (PSQ < 5.2) ($n = 53$)	High PSQ score (PSQ ≥ 5.2) ($n = 59$)	p value
Demographics			
Age (years)	70.6 (6.8)	71.1 (6.9)	NS
Gender (female, %)	45 (84.9%)	52 (88.1%)	NS
BMI (kg/m^2)	25.4 (3.7)	25.5 (2.9)	NS
PSQ total score	3.9 (0.9, 2.1–5.1)	6.3 (0.8, 5.3–10.0)	< 0.001
PSQ minor score	2.8 (0.9, 1.1–5.0)	5.1 (1.2, 3.1–10.0)	< 0.001
PSQ moderate score	4.9 (1.1, 2.4–7.7)	7.5 (0.8, 5.7–10.0)	< 0.001
ASA grade			
1	13 (24.5%)	17 (28.8%)	NS
2	40 (75.5%)	42 (71.2%)	
Operation time (min)	117.6 (32.6)	106.8 (27.2)	NS
Tourniquet time (min)	44.8 (10.3)	43.5 (9.0)	NS
Specific comorbidities			
Hypertension	29 (54.7%)	22 (55.9%)	NS
Diabetes	9 (17.0%)	10 (16.9%)	NS
Cardiac disease	6 (11.3%)	11 (18.6%)	NS
Cerebrovascular event	5 (9.4%)	4 (6.8%)	NS
Kidney disease	2 (3.8%)	1 (1.7%)	NS
Thyroid disease	2 (3.8%)	6 (10.2%)	NS
Pulmonary disease	4 (7.5%)	5 (8.5%)	NS
Liver disease	2 (3.8%)	1 (1.7%)	NS
Hemovac drainage (mL)	502.7 (233.1)	479.5 (247.2)	NS
Preoperative HKA (°)	Varus 10.1 (5.1)	Varus 9.1 (4.9)	NS
Postoperative HKA (°)	Varus 0.9 (2.1)	Varus 1.0 (2.1)	NS
Outlier of postoperative HKA	4 (7.5%)	6 (10.2%)	NS
Preoperative FC	5.7 (4.9)	6.2 (4.9)	NS
Preoperative FF	118.5 (10.7)	117.7 (12.6)	NS
Postoperative FC	0.3 (1.1)	0.4 (1.3)	NS
Postoperative FF	126.3 (5.1)	125.7 (4.8)	NS
PCA consumption (mL)	47.7 (24.9)	60.2 (30.8)	0.045
Tridol consumption (times)	3.5 (3.1)	6.3 (4.8)	0.001
NSAID usage (months)	3.1(1.4)	3.8 (1.6)	0.011

Values are presented as mean and SD

PSQ Pain Sensitivity Questionnaire, *BMI* Body Mass Index, *ASA* American Society of Anesthesiologists, *HKA*, hip–knee–ankle angle, *FC* flexion contracture, *FF* further flexion, *PCA* patient-controlled analgesia, *NSAID* non-steroidal anti-inflammatory drugs

In OA patients, increased pain sensitivity in areas other than the affected joint is called systematic hyperalgesia [2, 14]. Approximately, 20–30% of knee OA patients manifest systematic hyperalgesia [10, 30]. In most knee OA patients, preoperative widespread pain sensitivity caused by severe knee joint pain is mostly normalized after TKA surgery [1]. However, our study results showed that patients with high preoperative pain sensitivity not only had more severe preoperative pain than those with lower pain sensitivity but also exhibited more severe pain after surgery. Preoperative low pain threshold is a factor related to persistent pain after TKA surgery [28].

Valeberg et al. [39] examined the association between PSQ and post-TKA pain in 71 TKA patients. Only PSQ minor score was associated with postoperative pain patterns in young patients under 70 years of age. There exist two limitations to Valeberg et al.'s study [39]. First, patients were followed for only a short period of 8 weeks. It is well known that post-TKA pain persists for at least 3 months. [34]. Therefore, a longer follow-up period is needed to find out the appropriate relationship between pain sensitivity and postoperative pain after TKA. Second, they did not assess PROMs after TKA. TKA is a pain-relieving and function-restoring surgery. In this study, our study population was

Table 3 Pain VAS on resting, walking, nighttime, and average

	Low PSQ score (PSQ < 5.2) ($n = 53$)	High PSQ score (PSQ ≥ 5.2) ($n = 59$)	p value
Resting pain VAS			
Preoperative	3.0 (1.3)	3.8 (1.4)	0.004
Postoperative 6 weeks	1.3 (0.9)	2.1 (1.4)	< 0.001
Postoperative 3 months	1.2 (0.9)	1.8 (1.1)	0.002
Postoperative 6 months	0.7 (0.8)	1.2 (0.9)	0.003
Postoperative 1 year	0.5 (0.6)	0.9 (0.8)	0.003
Walking pain VAS			
Preoperative	6.5 (0.6)	7.3 (0.9)	< 0.001
Postoperative 6 weeks	2.8 (1.1)	3.9 (1.6)	< 0.001
Postoperative 3 months	2.8 (1.0)	3.5 (1.2)	0.001
Postoperative 6 months	2.1 (0.6)	2.9 (1.1)	< 0.001
Postoperative 1 year	1.7 (0.8)	2.3 (1.0)	0.002
Nighttime pain VAS			
Preoperative	4.7 (0.7)	5.3 (1.3)	0.002
Postoperative 6 weeks	2.7 (1.3)	4.1 (1.8)	< 0.001
Postoperative 3 months	2.1 (1.0)	2.8 (1.4)	0.003
Postoperative 6 months	1.0 (1.2)	1.7 (1.4)	0.007
Postoperative 1 year	0.7 (0.8)	1.2 (1.0)	0.004
24 h average pain VAS			
Preoperative	5.7 (0.7)	6.5 (0.8)	< 0.001
Postoperative 6 weeks	2.4 (1.0)	3.4 (1.4)	< 0.001
Postoperative 3 months	2.4 (1.1)	3.3 (1.0)	< 0.001
Postoperative 6 months	1.4 (0.7)	2.4 (1.0)	< 0.001
Postoperative 1 year	1.3 (0.7)	2.1 (1.2)	< 0.001

Data are presented as mean (standard deviation)

VAS visual analog scale

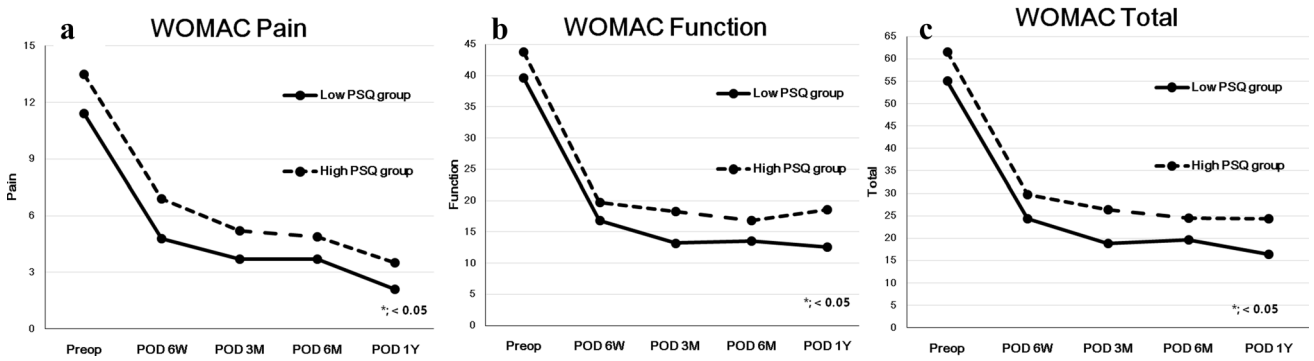

Fig. 2 Comparisons of the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) Pain (**a**), function (**b**), and total score (**c**). *PSQ* Pain Sensitivity Questionnaire, *POD* postoperative

followed for 1 year and PROMs were evaluated using WOMAC score and patient satisfaction. PSQ is a validated simple screening tool for pain sensitivity in patients undergoing TKA that can be used to demonstrate the effect of pain sensitivity on PROMs as well as postoperative pain levels. Kim et al. [18] investigated the relationship between PSQ and postoperative pain in spine surgery and found the occurrence of more severe pain levels and inferior clinical results up to 1 year after surgery in the group with a high PSQ score compared to the group with a low PSQ score. This is in line with our findings.

The PSQ consists of minor, moderate, and total scores [36]. In this study, the PSQ minor score was 4.0, the moderate score was 6.2, and the total score was 5.1. In

Table 4 Results of correlations between the PSQ score and Pain VAS, WOMAC total score

Timeline	Variance	Correlation coefficient	*p* value
PSQ total score			
Preoperative	Pain VAS average	0.368	< 0.001
	WOMAC total score	0.266	0.002
Postoperative 6 weeks	Pain VAS average	0.350	< 0.001
	WOMAC total score	0.323	< 0.001
Postoperative 3 months	Pain VAS average	0.292	0.001
	WOMAC total score	0.212	0.013
Postoperative 6 months	Pain VAS average	0.531	< 0.001
	WOMAC total score	0.256	0.003
Postoperative 1 year	Pain VAS average	0.252	0.004
	WOMAC total score	0.334	< 0.001
PSQ minor score			
Preoperative	Pain VAS average	0.321	< 0.001
	WOMAC total score	0.206	0.015
Postoperative 6 weeks	Pain VAS average	0.283	0.001
	WOMAC total score	0.322	< 0.001
Postoperative 3 months	Pain VAS average	0.301	0.001
	WOMAC total score	0.158	0.048
Postoperative 6 months	Pain VAS average	0.435	< 0.001
	WOMAC total score	0.215	0.011
Postoperative 1 year	Pain VAS average	0.198	0.019
	WOMAC total score	0.302	0.001
PSQ moderate score			
Preoperative	Pain VAS average	0.369	< 0.001
	WOMAC total score	0.305	0.001
Postoperative 6 weeks	Pain VAS average	0.366	< 0.001
	WOMAC total score	0.304	0.001
Postoperative 3 months	Pain VAS average	0.252	0.005
	WOMAC total score	0.256	0.003
Postoperative 6 months	Pain VAS average	0.555	< 0.001
	WOMAC total score	0.255	0.003
Postoperative 1 year	Pain VAS average	0.316	< 0.001
	WOMAC total score	0.356	< 0.001

PSQ Pain Sensitivity Questionnaire, *VAS* visual analog scale, *WOMAC* Western Ontario and McMaster Universities OA Index

a previous study of patients with TKA, a minor score of 2.7, moderate score of 5.1, and total score of 4.0 were lower than in our results [39]. In a study of patients with lumbar disc herniation, a minor score of 5.4, moderate score of 6.5, and total score of 6.0 were slightly higher than in our results [4]. In a PSQ validation study, it was reported that the PSQ minor score had a similar or slightly higher correlation with pain intensity compared to the PSQ total score [36]. A study in TKA patients also found that the PSQ minor and postoperative pain level had a higher correlation [39]. Groups with high and low PSQ scores were classified using the PSQ total score based on results from previous studies [4, 18, 19], and it was confirmed that the higher the PSQ, the more severe the postoperative pain level. Therefore, in patients undergoing TKA surgery, it is necessary to evaluate preoperative PSQ and provide information on postoperative pain sensitivity to patients through this result.

This study has several limitations. First, most patients in this study were women (87%). Most patients undergoing TKA surgery in Korea are women, and the reasons for this remain unclear [16, 17, 21, 40]. Second, the cut-off used to differentiate high and low PSQ scores was 5.2 in this study [4]. However, there is no validated cut-off value for dividing high and low PSQ following TKA. Kim et al. classified high and low PSQ based on a PSQ total score of 6.5 [18], but the PSQ score was higher than seen in our study patients, so the same criteria were not applied. In this study, with reference to the results of a previous study that evaluated postoperative clinical outcomes in lumbar surgery [4]. Third, the data of this study were collected prospectively but analyzed retrospectively with only data from one hospital and procedures performed by a single surgeon. Therefore, there may be a selection bias. To prevent bias as much as possible, carefully defined selection criteria were used and the outcome measurement of selected patients was performed using a clear and homogenous proven measurement tool. Also, all data were acquired in a similar way [33]. Fourth, fibromyalgia [7], restless leg syndrome [8], and other disorders are closely related to increased pain sensitivity. Excluding these patients could have caused selection bias. However, the purpose of this study was to investigate the relationship between changes in pain sensitivity due to knee OA and postoperative PROMs in patients who underwent TKA. For this reason, we sought to exclude all causes of increased pain sensitivity other than knee OA. Fifth, a follow-up period of one year is relatively short. Long-term follow-up is needed to investigate the relationship between pain sensitivity, clinical manifestations, and surgical outcomes after TKA more clearly. Sixth, WOMAC alone has limitations for evaluating disease-specific and generic PROMs. It would be useful to add a generic PROM such as short-form (SF)-36 or EuroQol (EQ)-5D; however, in this study, we did not employ a generic PROM measure [35]. Finally, this study could be underpowered and subject to type II errors when it comes to detecting all relevant outcomes. Therefore, a larger prospective study is needed. Despite these limitations, this study provides valuable information on the association between pain sensitivity and postoperative pain intensity following TKA.

For clinical relevance, preoperative screening of pain sensitivity using PSQ is useful for identifying patients with increased pain sensitivity. Therefore, patients should be educated about postoperative pain levels due to differences in pain sensitivity, and should understand differences in postoperative pain levels according to pain sensitivity following TKA. In addition, particular attention should be paid to patients with increased pain sensitivity for appropriate postoperative pain control after surgery.

Conclusion

In conclusion, in this study, increased pain sensitivity was a factor related to higher postoperative pain levels and inferior PROMs in patients undergoing primary TKA. Therefore, it is necessary to screen pain sensitivity before surgery and to evaluate postoperative pain and clinical manifestations in patients with high PSQ scores. In addition, pain control after surgery should be emphasized in patients with a high PSQ.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This study was approved by the Institutional Review Board (IRB) of Seoul St. Mary's Hospital.

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