Article

Journal of Orthopaedic Surgery

Journal of Orthopaedic Surgery
28(1) 1–6

DOI: 10.1177/2309499019895650
journals.sagepub.com/home/osj
SAGE

Effect of sedation anesthesia on kinesiophobia and early outcomes after total knee arthroplasty

Erdem Degirmenci[1], Kutay Engin Ozturan[2], Yasin Emre Kaya[2], Akcan Akkaya[3] and İstemi Yucel[4]

Abstract

Background: Total knee arthroplasty (TKA) operation is an effective treatment method in severe osteoarthritis worldwide. However, the number of patients with chronic pain and functional limitations in the postoperative period will continue to increase. Kinesiphobia is an important factor that affects the functional outcomes postoperatively. The aim of this study is to investigate the effects of intraoperative consciousness of the patients during surgery on kinesiophobia development and early functional outcomes of TKA. **Methods:** Sixty patients with the diagnosis of primary knee osteoarthritis were enrolled in the study. Tampa Scale of Kinesiophabia (TSK) was obtained for each patient at multiple time periods. Regional anaesthesia and deep sedation were performed on group 1 ($n = 30$), while regional anaesthesia and light sedation were performed on group 2 ($n = 30$). The same surgical procedures were applied to all participants. Functional tests were performed on the patients at the postoperative 2nd and 5th days. Visual Analogue Scale (VAS) scores and knee flexion angles were also measured postoperatively. **Results:** The mean age of the participants (19 men (31.7%) and 41women (68.3%)) was 67.7 $\pm$ 6.7 (54–82) years. TSK $\geq$ 40 was detected in 18 (30%) patients preoperatively and 33 patients (55%) postoperatively. The number of kinesiophobic patients showed statistically significant increase after operation (20/30 (66.7%)) according to preoperative period (9/30 (30%)) in group 2 ($p = 0.003$). Postoperative functional scores, knee flexion angles and VAS scores were better in non-kinesiophobic patients. **Conclusion**: Patient's consciousness during TKA operations is an important factor that interferes with the postoperative kinesiophobia development, which may play a pivotal role affecting the early mobility and functional outcomes.

Keywords

kinesiophobia, sedation anaesthesia, Tampa Scale, total knee arthroplasty

Date received: 30 July 2019; Received revised 31 October 2019; accepted: 28 November 2019

Introduction

Degenerative knee joint disorders are progressive pathologies with severe pain leading to multiple analgesic abuse and gait difficulties.[1] Not only physical but also a social and psychological burden deteriorating the quality of life of patients, degenerative knee joint disorders are serious orthopaedic problems that are mandatory to treat.

Total knee arthroplasty (TKA) operation is a common and effective treatment in severe degenerative knee joint disorders worldwide.[2] The primary outcomes of the procedure are mobility in the early period, increase in

[1] Department of Orthopaedic and Traumatology, Faculty of Medicine, Duzce University, Duzce, Turkey
[2] Department of Orthopaedic and Traumatology, Faculty of Medicine, Abant Izzet Baysal University, Bolu, Turkey
[3] Department of Anaesthesia, Faculty of Medicine, Abant Izzet Baysal University, Bolu, Turkey
[4] Department of Orthopaedic and Traumatology, Private Mehmet Toprak Hospital, Istanbul, Turkey

Corresponding author:
Erdem Degirmenci, Department of Orthopaedic and Traumatology, Faculty of Medicine, Duzce University, +9081620 Yorukler Mh. Konralp, Duzce, Turkey.
Emails: erddegir@gmail.com; erddegir@yahoo.com

functionality, dramatic decrease in pain, and increased self-confidence of the patients as a consequence.[3] Postoperative (PO) pain control, mobilization and physical therapies are the milestones of successful surgical outcomes.[4] However, some patients may report displeasure due to discordance with physical therapy and chronic pain.[5] It has been reported that psychological factors, such as pain catastrophizing and kinesiophobia, strongly influence pain perceptions and responses to physical activity,[6,7] which can lead to illness behaviour and subsequent disability characterized by poor cognitive and physical performance, such as disuse syndrome, anxiety, depression and decreased physical function, thus creating a vicious circle of pain and disability after musculoskeletal injury or surgery.[8]

Fear of re-injury is similar to fear of movement/re-injury, also called kinesiophobia, which is a primary psychosocial construct in the fear-avoidance model.[9] The fear-avoidance model was developed to describe the transition from acute to chronic pain in patients with low back pain.[10]The injury or surgery can create feelings of uncertainty and fear of how far the injury will affect future function.[11] This causes the individual's negative attitudes toward the body and participating in daily activities and sports.

The Tampa Scale of Kinesiophobia (TSK) is a widely used instrument to assess kinesiophobia and has been applied to various pain conditions such as chronic low back pain, fibromyalgia, osteoarthritis, traumatic neck pain, sports injury, sickle cell disease and burn pain.[12]

There are a limited number of studies about the aetiology and psychological pattern of kinesiophobia in the literature. Based on our clinical experience, perioperative interactions could also be effective in the early occurrence of kinesiophobia and the clinical outcomes as well. Moreover, patients who are conscious during surgery can be more vulnerable for the kinesiophobia development afterwards. In this aspect, we aimed to evaluate the effects of anaesthesia type during TKA operations on early kinesiophobia and the clinical outcomes.

Materials and methods

The study was approved by the Local Ethics Committee and all patients signed a written informed consent form. The minimum required sample size was calculated as 23 in each group based on the mean TSK scores reported by Roelofs et al.[12] The statistical power level of significance and effect size were set at 90%, 5% and the change of one standard deviation, respectively. Sixty patients with the diagnosis of primary knee osteoarthritis, who were candidates for unilateral TKA, were included in the study. All surgical and anaesthetic procedures were performed by the same surgical team.

Participants who met the following criteria were enrolled in the study: older than 18 years, diagnosed with primary osteoarthritis and the ability to read and speak the Turkish language. Patients who had rheumatoid arthritis, prior knee surgery or fracture, scheduled for revision knee arthroplasty, venous thromboembolism, history of chronic narcotics usage, severe obesity (body mass index > 40 kg/m^2), musculature disease or neurological disorder which can limit the activity of lower extremities and mental disorder that prevented them from understanding the questionnaires and PO early complication were excluded.

TSK was obtained for each patient at multiple time periods, including preoperatively and PO 2nd and 5th days. All the data were filled by the patients themselves, because kinesiophobia usually occurs after surgery, and within the first 48 h was the best time for assessment.[10]

All patients underwent the standard preparation process for surgery and were randomly assigned to two groups by simple randomization using random numbers table. Regional anaesthesia and deep sedation were performed on group 1 ($n = 30$) in order to set unconsciousness with Bispectral Index Score (BIS) between 60 and 70, while regional anaesthesia and light sedation were performed on group 2 ($n = 30$) in order to set conscious sedation with BIS up to 80.

Functional tests including two-minute walk test (2-MWT) and Timed Up and Go test (TUGT) were conducted on the patients at PO 2nd and 5th days. The changes between the scores were recorded. Visual Analogue Scale (VAS) scores and range of motion (ROM) angles were also measured at the PO 5th day. All patients were discharged at the 5th day postoperatively.

Surgical method

Spinal anaesthesia was attained with 15 mg/3 mL 0.5% bupivacaine (Marcaine® 20 mL flacon, AstraZeneca, Istanbul, Turkey) injected aseptically using 22 G needle (Egemen International, İzmir, Turkey) in the subarachnoid space at the L4–5 levels. Before making the surgical incision, the anaesthesia block level was evaluated using pinprick testing at the level of the inguinal ligament and motor block at the knee joint. Group 1 was sedated with 2 mg of midazolam and 60 mg of Lidocaine. Midazolam was titrated due to the BIS, which should be in the ranges of 60–70.[13] These patients were inhaled with 7 L/min of oxygen. Patients in group 1 were closely monitored with thumb pulseoxymeter measurements by anaesthesiologists with consciousness examinations. Midazolame of 1 mg was administered intravenously to the patients in group 2 with a BIS above 85. Thus, anxiolysis was maintained in the patients. This light hypnotic state led the continuity of the patients' perceptions.[13]

A mid-vastus approach was performed on all patients. After performing the femoral and tibial cuts, posterior stabilized femoral component, tibial components and fixed insert (Zimmer®, Warsaw, Indiana, USA) were implanted and cemented. Postoperatively, all patients were given systemic prophylactic antibiotics and anticoagulant to

decrease deep venous thrombosis and infection risk. The standard PO analgesic protocol was performed on both groups, including application of paracetamol and diclofenac sodium intravenously. Patient-controlled analgesia was applied during 48 h following surgery. Patients of both groups were subjected to the same PO intervention, including the pain management and rehabilitation exercises during hospitalization. The physiotherapy protocol was applied under the supervision of the same physiotherapist in a progressive manner immediately after surgery. The physiotherapist, nurses and all study staff, who helped the patients with rehabilitation exercises, medication and so on, were also blinded to the intervention to avoid introduction of potential bias.

Fear of movement measurement

A 17-item Turkish version of the self-reported TSK questionnaire[14] was used to determine the fear of movement level in the TKA patients. Each item was scored using a four-point Likert-type scale ranging from 1 (*Strongly disagree*) to 4 (*Strongly agree*), and the total score was calculated by adding the scores of the individual items (range: 17–68) with higher scores indicating a greater degree of fear of movement.[15] Lundberg et al. concluded that the TSK value greater than 40 is an indication of kinesiophobia.[16] The cut-off kinesiophobia score for our study was set at 40. TSK was used to assess all the patients preoperatively and 2nd and 5th days postoperatively.

ROM and VAS

A standard long-arm goniometer was used to obtain all ROM measurements. With the patient supine, active knee flexion was measured after instructing the patient to maximally flex the ipsilateral knee.

Ten-point VAS ranging from 0 (*No pain at all*) to 10 (*The worst imaginable pain*) was used to assess the pain levels.[17] Knee active ROM for flexion was measured using a universal goniometer.[18]

Functional tests

2-MWT was used to measure functional walking capacity. On the 2nd and 5th days postoperatively, patients were asked to walk for a 2-min time period and the distance was recorded in metres.[19]

The patients were asked to get up from a chair, walk 3 min with their assistive device, turn around and walk back to the chair as quick as possible to measure the TUGT on the 2nd and 5th days after surgery, to assess the mobility, static and dynamic balance.

Statistical analysis

Normality assumption was examined using Kolmogorov–Smirnov test. Comparisons between groups in terms of continuous data were done with Independent Samples *t*-test, while χ^2 test was used for categorical data. Changes in the TSK scores within groups were analysed with repeated measures analysis of variance (ANOVA). Preoperative and PO kinesiophobia rates were analysed with McNemar test. Statistical analyses were done with the IBM SPSS v.22 statistical package and the statistical significance level was considered as 0.05.

Ethical approval

All procedures performed in the study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent

Written informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this article.

Results

Sixty participants (19 men (31.7%) and 41women (68.3%)) were enrolled in the study. All patients enrolled in the study were included in the final analysis. The mean age was 67.7 $\pm$ 6.7 (range 54–82) years and 14 (23.3%) patients had a high school or higher education. The preoperative TSK score $\geq$40 was detected in 18 (30%) patients, among which 2 were men, 16 were women and only 3 (16.7) of them had a higher education; among the 4 illiterate patients, 3 (75%) had a TSK score $\geq$40. These patients were equally divided into both the groups.

The TSK score was $\geq$ 40 in 33 (55%) patients at the PO 2nd day evaluation; 13 (39.4%) of them were from group 1 and 20 (60.6%) of them were from group 2 ($p = 0.069$). The frequency of patients with kinesiophobia in groups 1 and 2 was 43.3% and 66.7%, respectively. Since the rate of kinesiophobia in group 2 was higher than in group 1, no statistically significant difference was detected ($p = 0.069$).

Among the 13 patients with kinesiophobia, 9 (69.2%) had TSK scores > 40 in group 1 preoperatively, and only 4 (30.8%) of them were de novo diagnosed as kinesiophobia, postoperatively. There were no statistically significant differences in the increase of the PO TSK scores in group 1 ($p = 0.125$).

Eight (40%) of the 20 patients had higher preoperative TSK score in group 2 and 12 (60%) of them were measured as new kinesiophobic patients postoperatively. The TSK score was measured as <40 in 1 (11.1%) patient who had a high TSK score preoperatively ($p = 0.003$). The number of kinesiophobic patients showing statistically significant increase after operation was 20/30 (66.7%))

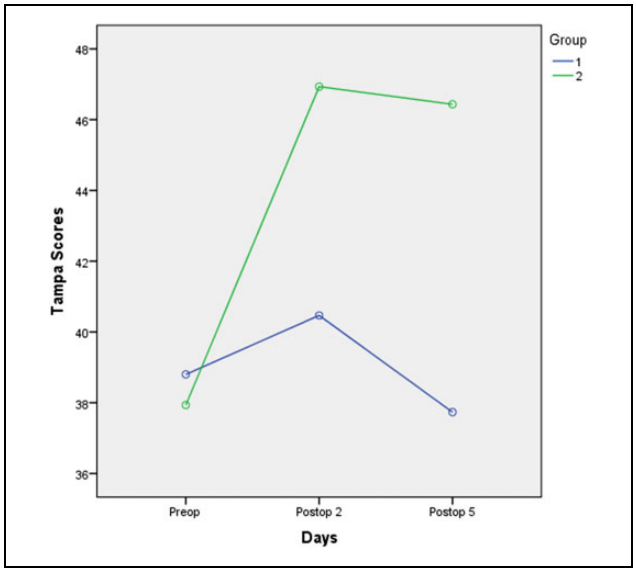

Figure 1. Changes in the TSK scores of groups.
TSK: Tampa Scale of Kinesiophobia.

Table 1. TSK score interaction between the groups and the time of measurement.

	Group	Mean	SD	N
TSK score Preoperative	1	38.80	5.927	30
	2	37.93	7.196	30
TSK score PO 2nd day	1	40.47	6.078	30
	2	46.93	10.366	30
TSK score PO 5th day	1	37.73	5.663	30
	2	46.43	9.995	30

TSK: Tampa Scale of Kinesiophobia; PO: postoperative.
1: Spinal anaesthesia + deep sedation; 2: Spinal anaesthesia+ light sedation.

in the preoperative period (9/30 (30%)) in group 2 ($p = 0.003$) (Figure 1).

When we evaluated the association of TSK scores with the anaesthesia methods used between the study groups, a statistically significant correlation was detected ($p < 0.001$) (Table 1). Decreased TSK scores during rehabilitation were consistent with the lesser kinesiophobia experience after rehabilitation.

While we evaluated the PO functional status of the patients with the 2-MWT, mean value of 33 kinesiophobic patients was found to be 25.76 $\pm$ 4.5 and 36.15 $\pm$ 4.16 m for non-kinesiophobic patients ($p < 0.001$).

PO 2nd and 5th day mean values of the groups in terms of 2-MWT are shown in Table 2. In group 1, 2-MWT was measured as 33.1 $\pm$ 6.4 and 27.8 $\pm$ 6.1 m, and in group 2 at PO 2nd day ($p = 0.002$; Table2). Similarly, 2-MWT test scores were better in group 1 than group 2 in PO 5th day evaluation (36.5 $\pm$ 6.7/30.5 $\pm$ 6.4; $p = 0.001$). In the PO 2nd and 5th day evaluations, the scores of group 1 were higher than those in group 2. According to these results, we

Table 2. Postoperative functional tests, ROM, and VAS scores.

Postoperative evaluation	Kinesiophobic patients (TSK score $\geq$40)	Patients without kinesiophobia (TSK score <40)	*p* Value
2-MWT (m)	25.76 $\pm$ 4.5	36.15 $\pm$ 4.16	<0.001
TUGT (s)	48.7 $\pm$ 6.2	44.7 $\pm$ 5.6	0.011
ROM (°)	64.9 $\pm$ 8.1	84.1 $\pm$ 6.3	<0.001
VAS	6.6 $\pm$ 0.9	4.2 $\pm$ 0.8	<0.001

ROM: range of motion; VAS: Visual Analogue Scale; TSK: Tampa Scale of Kinesiophobia; 2-MWT: two-minute walk test; TUGT: Timed Up and Go test.

can predict that kinesiophobia affects the early PO functional outcomes negatively.

TUGT was another functional test that was evaluated postoperatively. The mean TUGT score was 44.7 $\pm$ 5.6 s in non-kinesiophobic patients and 48.7 $\pm$ 6.2 s in kinesiophobic patients in PO 2nd day evaluation ($p = 0.011$). Also in group 1, TUGT score was 44.9 $\pm$ 6.1 s and 48.8 $\pm$ 5.8 s in group 2 and the statistically significant difference was detected between the groups in the PO 2nd day evaluation ($p = 0.014$). Similarly, the difference in the 5th day scores was 41.3 $\pm$ 6.6 s in group 1 and 45.3 $\pm$ 6.9 s in group 2 ($p = 0.025$).

ROM of the knee joint was evaluated on the discharge day. Mean flexion angle was measured as 64.9 $\pm$ 8.1° in kinesiophobic patients and 84.1 $\pm$ 6.3° in non-kinesiophobic patients. The VAS score was 4.2 $\pm$ 0.8° in non-kinesiophobic patients and 6.6 $\pm$ 0.9° in kinesiophobic patients ($p < 0.001$; Table2).

The mean duration of hospitalization was similar in all the patients, all were discharged on PO 5th day.

Discussion

Despite the developments in surgical, medical and anaesthetic techniques, refined prosthesis designs, as well as the physiotherapy options, PO satisfaction of the patients following TKA, do not show similar improvement.

Regardless of surgical complications and preoperative comorbidity, 15–30% of the TKA patients complain of persistent pain after surgery.[20–22] According to the fear-avoidance model, various psychological factors, such as depression, pain catastrophism and kinesiophobia, can be risk factors for persistent pain and disability.[23] Studies have shown that, for many patients, pain persists following TKA, in spite of objective indicators of surgical success.[24,25]

PO kinesiophobia was reported by Libai et al. as 24.4% in China, while the rates in France and Serbia were 35.96% and 21.79%, respectively. The differences in the rates between these countries can be attributed to the varying sample size, demographic and socio-cultural features of the studies.[26–28] Similar to the literature, PO kinesiophobia rate in our study was found to be 39.4% in group 1.

Table 3. Detailed data of patients.

	Group 1	Group 2	*p* Value
Sex (M/F)	9/21	10/20	0.781
Education (high/low)	24/6	22/8	0.542
Age (year)	67.9 ± 7.0	67.5 ± 7.0	0.826
TSK score, preoperative	38.8 ± 5.9	37.9 ± 7.2	0.613
TSK score, PO 2nd day	40.5 ± 6.1	46.9 ± 10.4	0.005
TSK score, PO 5th day	37.7 ± 5.7	46.4. ± .10.0	<0.001
2-MWT, 2nd day (m)	33.1 ± 6.4	27.8 ± 6.1	0.002
2-MWT, 5th day (m)	36.5 ± 6.7	30.5 ± 6.4	0.001
TUGT, 2nd day (m)	44.9 ± 6.1	48.8 ± 5.8	0.014
TUGT, 5th day (m)	41.3 ± 6.6	45.3 ± 6.9	0.025
ROM (°)	77.4 ± 11.1	69.6 ± 11.8	0.011
VAS	4.9 ± 1.2	6.1 ± 1.6	0.002

TSK: Tampa Scale of Kinesiophobia; 2-MWT: two-minute walk test; PO: postoperative; TUGT: Timed Up and Go test; ROM: range of motion; VAS: Visual Analogue Scale.

Demonstrating the effects of socio-demographic features, Edwards et al. reported that patients with a lower educational status are more prone to develop kinesiophobia, due to their poorer pain definition and difficulty in coping with pain.[29] Lack of social support, female gender and negative coping are also reported as risk factors for kinesiophobia.[30] However, there is a debate about older age. Cook et al. revealed a lower TSK in older patients,[31] while Stubbs and Libai reported an increase in the frequency of kinesiophobia as people age.[28,32] Conversely, Gunn revealed that kinesiophobia is an independent parameter regardless of age and gender.[33] Our results were consistent with the literature, indicating that lower education status, female gender and older age are risk factors for kinesiophobia development. Besides, our clinical experience reveals that the intraoperative anaesthesia method interferes with the PO early development of anxiety and fear, which are important factors affecting the functional capacity of patients. However, there are no data in the previous studies according to our literature review.

Gunn et al. demonstrated a direct correlation between kinesiophobia development and psychological variables including depressive symptoms, self-efficacy, pain catastrophism and negative coping in patients with severe knee osteoarthritis.[33] In this aspect, directly addressing the psychological variables could help to improve physical activity levels and clinical outcomes and prevention of kinesiophobia as well. Cognitive behavioural therapy can also be helpful to help patients decrease catastrophizing behaviours. Monticone et al. reported that multidisciplinary intervention after TKA could consistently improve kinesiophobia in patients and outcomes, as well.[8] Since early detection of kinesiophobia is an important predictor of improved clinical outcome after TKA operations, Sullivan et al. defined several tests for the detection of kinesiophobia.[30] Similar to the literature, we performed 2-MWT, TUGT and ROM measurements in order to evaluate the functional outcomes.[34]

We investigated the effects of consciousness during surgery in which patients are able to perceive sounds, vibrations, applied forces and the interpretations of the surgical team on the kinesiophobia development and the early clinical outcomes. The principal finding of this study was that the anaesthetic methods used in surgery directly affect the early TSK scores and functional outcomes in TKA patients. Patients in group 1 who received deep sedative anaesthesia had a focused intent to move and heal without any fear, while patients in group 2 had hesitations to move due to their sense of fear and anxiety in the early PO period. Moreover, PO TSK scores of the patients in group 2 were found to be statistically significantly increased, as provided in detail in Table 3 ($p = 0.003$).

The major limitation of our study was the lack of data revealing the long-term outcomes of the patients following TKA. Thus, further studies with larger scales and long-term outcome assessments should be performed to clarify the course of kinesiophobia development in orthopaedic surgeries.

Conclusion

To conclude, anaesthesia methods performed during TKA operations are important factors interfering with the PO kinesiophobia, which may play a pivotal role affecting the early mobility, functional outcomes and recovery of patients.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship and/or publication of this article.

ORCID iD

Erdem Degirmenci https://orcid.org/0000-0002-7988-4261

References

1. Shelby RA, Somers TJ, Keefe FJ, et al. Fear of movement scale for osteoarthritis. *Arthritis Care Res (Hoboken)* 2012; 64(6): 862–871.
2. Heck DA, Robinson RL, Partridge CM, et al. Patient outcomes after knee replacement. *Clin Orthop Relat Res* 1998; (356): 93–110. PMID: 9917673.
3. Cremeans-Smith JK, Boarts JM, Greene K, et al. Patients' reasons for electing to undergo total knee arthroplasty impact post-operative pain severity and range of motion. *J Behav Med* 2009; 32(3): 223–233.
4. Koller-Hodac A, Leonardo D, Walpen S, et al. Knee orthopaedic device how robotic technology can improve outcome

in knee rehabilitation. *IEEE Int Conf Rehabil Robot* 2011; 2011: 5975347.
5. Kurtz S, Ong K, Lau E, et al. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. *J Bone Joint Surg Am* 2007; 89: 780–785.
6. Filardo G, Roffi A, Merli G, et al. Patient kinesiophobia affects both recovery time and final outcome after total knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc* 2016; 24: 3322–3328.
7. Hirakawa Y, Hara M, Fujiwara A, et al. The relationship among psychological factors, neglect-like symptoms and postoperative pain after total knee arthroplasty. *Pain Res Manag* 2014; 19: 251–256. PMCID: PMC4197752.
8. Monticone M, Ferrante S, Rocca B, et al. Home-based functional exercises aimed at managing kinesiophobia contribute to improving disability and quality of life of patients undergoing total knee arthroplasty: A randomized controlled trial. *Arch Phys Med Rehabil* 2013; 94: 231–239.
9. Vlaeyen JW and Linton SJ. Fear-avoidance and its consequences in chronic musculoskeletal pain: A state of the art. *Pain* 2000; 85: 317–332.
10. Kori S, Miller R and Todd D. Kinesiophobia: A new view of chronic pain behavior. *Pain Manag* 1990; 3: 35–43.
11. Osterberg A, Kvist J and Dahlgren MA. Ways of experiencing participation and factors affecting the activity level after non-reconstructed anterior cruciate ligament injury: A qualitative study. *J Orthop Sports Phys Ther* 2013; 43: 172–183.
12. Roelofs J, Van Breukelen G, Sluiter J, et al. Norming of the Tampa Scale for Kinesiophobia across pain diagnoses and various countries. *Pain* 2011; 5: 1090–1095.
13. Başar H, Ozcan S, Buyukkocak U, et al. Effect of bispectral index monitoring on sevoflurane consumption. *Eur J Anaesthesiol* 2003; 20: 396–400.
14. Yılmaz OT, Yakut Y, Uygur F, et al. Turkish version of the Tampa Scale for Kinesiophobia and its test-retest reliability. *Turk J Ph Med Rehab* 2011; 22: 44–49.
15. George SZ, Lentz TA, Zeppieri G, et al. Analysis of shortened versions of the Tampa scale for kinesiophobia and pain catastrophizing scale for patients after anterior cruciate ligament reconstruction. *Clin J Pain* 2012; 28: 73–80.
16. Lundberg MKE, Styf J and Carlsson SG. A psychometric evaluation of the tampa scale of kinesiophobiaefrom a physiotherapeutic perspective. *Physiother Theor Pract* 2004; 20: 121–133.
17. Huskisson EC. Measurement of pain. *Lancet* 1974; 9: 1127–1131. PMID: 4139420.
18. Jakobsen TL, Christensen M, Christensen SS, et al. Reliability of knee joint range of motion and circumference measurements after total knee arthroplasty: Does tester experience matter? *Physiother Res Intl* 2010; 15: 126–134.
19. Connelly DM, Thomas BK, Cliffe SJ, et al. Clinical utility of the 2-minute walk test for older adults living in long-term care. *Physiother Can* 2009; 61: 78–87.
20. Jones CA, Voaklander DC, Johnston DW, et al. Health related quality of life outcomes after total hip and knee arthroplasties in a community based population. *J Rheumatol* 2000; 27: 1745–1752. PMID: 10914862.
21. Kennedy DM, Hanna SE, Stratford PW, et al. Preoperative function and gender predict pattern of functional recovery after hip and knee arthroplasty. *J Arthroplasty* 2006; 21: 559–566.
22. Murray DW and Frost SJ. Pain in the assessment of total knee replacement. *J Bone Joint Surg* 1998; 80: 426–431. PMID: 9619930.
23. Heuts PH, Vlaeyen JW, Roelofs J, et al. Pain-related fear and daily functioning in patients with osteoarthritis. *Pain* 2004; 110: 228–235.
24. Brander VA, Stulberg SD, Adams AD, et al. Predicting total knee replacement pain: A prospective, observational study. *Clin Orthop Relat Res* 2003; 20: 27–36
25. Harden RN, Bruehl S, Stanos S, et al. Prospective examination of pain-related and psychological predictors of CRPS-like phenomena following total knee arthroplasty: A preliminary study. *Pain* 2003; 106: 393–400. PMID: 14659522.
26. Doury-Panchout F, Metivier JC and Fouquet B. Kinesiophobia negatively influences recovery of joint function following total knee arthroplasty. *Eur J Phys Rehabil Med* 2015; 51: 155–161. PMID: 25392087.
27. Kocic M, Stankovic A, Lazovic M, et al. Influence of fear of movement on total knee arthroplasty outcome. *Ann Ital Chir* 2015; 86: 148–155. PMID: 25952608.
28. Cai L, Liu Y, Xu H, et al. Incidence and Risk Factors of Kinesiophobia After Total Knee Arthroplasty in Zhengzhou, China: A cross-sectional study. *J Arthroplasty* 2018; 33: 2858–2862.
29. Edwards RR, Goble L, Kwan A, et al. Catastrophizing, pain, and social adjustment in scleroderma: Relationships with educational level. *Clin J Pain* 2006; 22: 639–646.
30. Sullivan M, Tanzer M, Stanish W, et al. Psychological determinants of problematic outcomes following total knee arthroplasty. *Pain* 2009; 143(1-2): 123–129.
31. Cook AJ, Brawer PA and Vowles KE. The fear-avoidance model of chronic pain: Validation and age analysis using structural equation modeling. *Pain* 2006; 121: 195–206.
32. Stubbs B, Hurley M and Smith T. What are the factors that influence physical activity participation in adults with knee and hip osteoarthritis? A systematic review of physical activity correlates. *Clin Rehabil* 2015; 29: 80–94.
33. Gunn AH, Schwartz TA, Arbeeva LS, et al. Fear of movement and associated factors among adults with symptomatic knee osteoarthritis. *Arthritis Care Res* 2017; 69(12): 1826–1833.
34. Deniz HG, Kınıklı G I, Çaglar O, et al. Does kinesiophobia affect the early functional outcomes following total knee arthroplasty? *Physiother Theory Pract* 2017; 33(6): 448–453.