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The effect of visual stimulation on kinesiophobia level and functional outcomes after total knee arthroplasty in patients with high kinesiophobia

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The aim of this study is to investigate the effect of the video of full flexion-extension movement of the operated knee on kinesiophobia level and functional results in the postoperative rehabilitation period in patients with high level of kinesiophobia who underwent total knee prosthesis surgery. For this purpose sixty patients with a preoperative Tampa Kinesiophobia Scale score above 39.5 and who underwent total knee replacement were included in this prospective study. The patients were randomly divided into two groups based on whether the video of their knee motion was captured. All patients were evaluated by using Tampa Scale for Kinesiophobia, SF-36 short form, Visual Analogue Scale, Range of Motion and 2-minute walk test before and 6 months after the surgery. As a results of the study the reduction in kinesiophobia level was not significant in either of the groups. There were significant improvements in both groups in terms of pain reduction, better range of motion and 2-minute walk test results. There was no significant difference between the two groups in the 2-minute walk test, but the improvement in pain reduction, knee flexion angle and quality of life were observed to be superior in the study group compared to the control group at the 6 month evaluation. At the end: Our results suggest that the rehabilitation performed with the help of the video as a visual stimulus is effective on increasing range of motion, reducing pain level and improving quality of life but not effective on levels of kinesiophobia.

Keywords: Visual stimulus, Total knee arthroplasty, Functional outcomes, Quality of life, Kinesiophobia level.

INTRODUCTION

Total knee arthroplasty (TKA) is an important orthopedic surgery for pain reduction, function and quality of life[1–3]. The prolongment of human life and increase in obesity in Western societies result in a remarkably elevated frequency of gonarthrosis and in consequence of TKA surgery[4]. Success after TKA surgery relies on effective rehabilitation treatment along with a successfully performed surgery[4]. The success in rehabilitation treatment is affected by both physical (age, sex, and body weight) and psychological (kinesiophobia, self-efficacy, pain catastrophizing) factors[5]. Ensuring an early return of the patient to functional daily life following a TKA surgery may not always be an easy task for healthcare providers. During the rehabilitation period, maintaining an appropriate level of daily physical activity is essential to improving knee function and managing the pain. However, people with high kinesiophobia may hesitate to continue their daily physical activities[6].

Kinesiophobia is defined as the patient's restraining of their physical activity caused by excessive fear of possible pain and it is one of the psychological factors affecting rehabilitation[7]. Kinesiophobia can lead to behavioral disorders such as decreased physical functions, inactivity and depression in patients. It was observed that active exercise and compliance with rehabilitation programs were higher in patients without kinesiophobia. Patients with higher kinesiophobia restrict their movements to prevent possible pain due to movement in the surgical areas. In such cases, the desired range of motion cannot be achieved during the rehabilitation phase; therefore, the intended level cannot be achieved in the daily activity of the patient. Along with possible muscle atrophy

due to rehabilitation deficiency, a well-done surgery may result in a poor knee function and unsatisfying outcome for the patient. Psychological factors such as kinesiophobia have been reported to impact the success of rehabilitation through the patient's perception of pain and rehabilitation compliance[7,8]. Filardo et al.[7] reported that kinesiophobia affects the success of TKA considerably as an independent factor apart from other psychological and physical factors. They further reported it as being an important indicator of increased pain and disability after the surgery. Many studies suggest kinesiophobia to be effective in the results of various surgeries[9-13]. As understood from these studies, reducing kinesiophobia in patients positively affects surgical results. The patients could be visually and verbally comforted in order to reduce kinesiophobia. It is possible that the way to improving success rates of surgeries is through reducing kinesiophobia.

The effects of cognitive behavioral therapy and video usage in reducing kinesiophobia have been mentioned in studies[4,14]. In both studies, given kinesiophobia was reduced, it was stated that the functional results improved early.

In our investigation, no study was found to reduce kinesiophobia by having the patient watch their own videos. The hypothesis of our study is that showing the patient's own joint range of motion under regional anesthesia after surgery can be used as a method of behavioral treatment and will contribute to rehabilitation in the early period by reducing kinesiophobia.

MATERIALS AND METHOD

This prospective study was conducted between July 2019 and April 2020 in the orthopedic clinic of the XXXX practice and research hospital. The inclusion criteria for the study were: Patients aged between 50 and 75 who were diagnosed with primary tri-compartmental gonarthrosis with varus deformity based on anteroposterior and lateral knee radiographs along with clinical examination, and whose preoperative Turkish Version Tampa Scale for Kinesiophobia (TSK) was higher than 39.5 points, and who underwent tri-compartmental posterior-cruciate substituting TKA surgery. Posterior cruciate substituting design knee prosthesis was applied to patients with more than 15 degrees of varus and flexion contracture[15].

TSK is a 17-question scale developed by Miller Kopri and Todd in 1991 to measure the fear of movement/re-injury (kinesiophobia). The scale includes injury/re-injury and fear-avoidance parameters in work and related activities. TSK was introduced into the literature by Vlasyen and his colleagues, with the permission of the original developers[16]. In the TSK evaluation, the patient receives a score between 17-68 depending on the answers he gives to the questions in the test. A high score indicates that kinesiophobia is also high[17]. The translation of this scale into Turkish and the proof of the reliability of the Turkish version were presented by Yılmaz ÖT and his colleagues[18].

Patients with secondary osteoarthritis (rheumatoid arthritis, post-traumatic arthritis, septic arthritis sequelae) or gonarthrosis with valgus deformity; patients who had posterior cruciate ligament retaining TKA; patients who had previously undergone a surgery to the same knee or TKA to the other knee; patients who had a wound problem or infection in the knee after the surgery; patients who were addicted to smoking, drugs or alcohol and patients who had previously had neurological or psychiatric diagnoses and therapy were excluded from the study. The patients were also excluded if they missed more than one rehabilitation session.

All participants were informed about the study procedure, purpose of the study, and known risks. They all gave their informed consent on the day that they registered. The protocol for the study was approved by the XXXX University Institutional Review Board (25.07.2019-01).

All patients underwent PCL substituting cemented fixed-bearing TKA using a Zimmer Nexgen LPS Fixed Knee System (Zimmer, Inc.1800 West Center Street Warsaw, Indiana 46580 USA) (Figure1, 2). All patients underwent the surgery with spinal anesthesia. Epidural or combined regional anesthesia was not used. The surgery started with a standard medial parapatellar incision. Tourniquet was used in all surgeries. In the operation of all patients, the tibial bone cut was made with a 7 degree slobe angle, and the distal femoral bone cut was made with a 6 degree valgus angle. An extra-medullary guide was used for the tibial alignment. Patella resurfacing was performed. Postoperative pain management was provided with the local cocktail (including morphine 1 ml, adrenaline 1 ml, cefazolin 1 gr, marcain 20 ml, depomedrol 1 ml, and physiological saline solution 27 ml)[19] and analgesics used intravenously. Then, the patients were randomized into the two groups for rehabilitation: Group A (n=30) treated with video containing a passive full flexion and extension motion of the surgical knee was captured while the patients were under anesthethics (***Video 1***) in addition to physical therapy. At the end of the video,

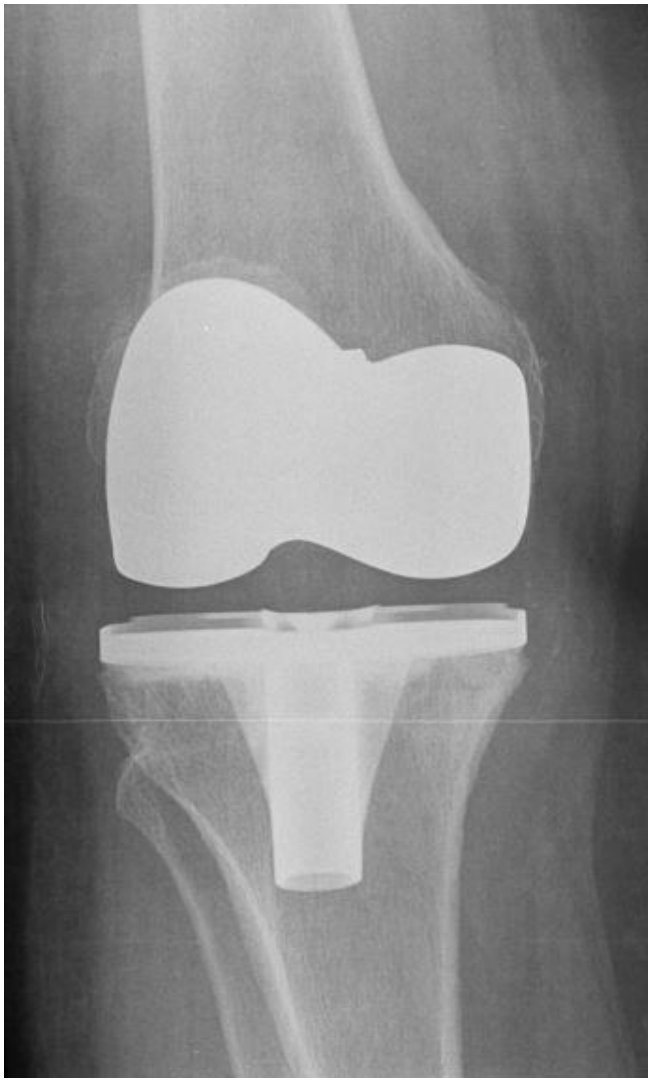

Fig. 1 — Anteroposterior radiograph of tri-compartmental total knee arthroplasty.

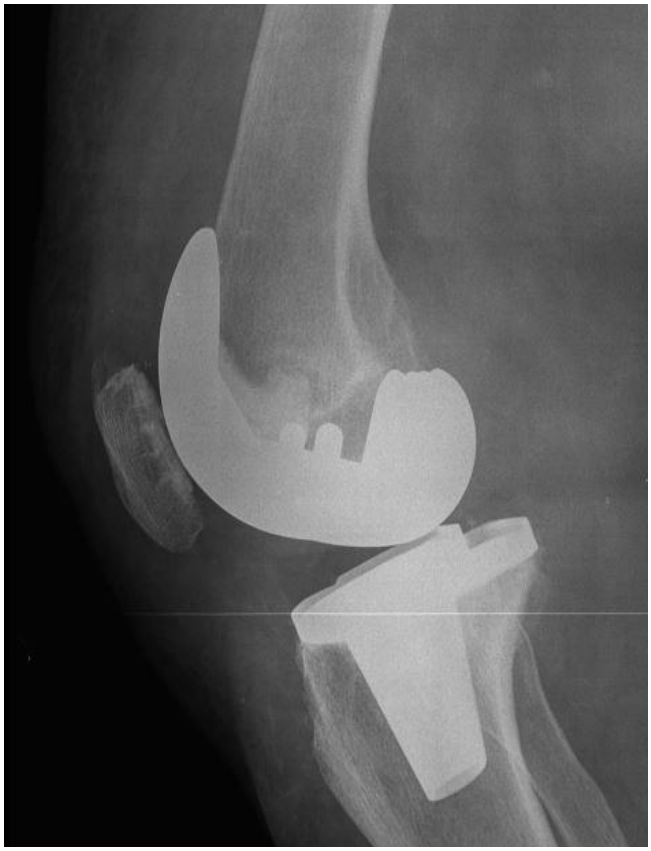

Fig. 2 — Lateral radiograph of tri-compartmental total knee arthroplasty.

Video 1: https://vimeo.com/manage/videos/1069957392/fd8d3bfc9b

Video containing the full flexion-extension motion of the patient's operated knee after total knee arthroplasty surgery.

the patients' face were clearly seen, and each video was ended by talking with the patient. Group B (n=30) only attended physical therapy.

The captured video was shown daily to the patients in group A before every rehabilitation session. The video of each patient was also sent to the their phone through an application. They were instructed to watch the video each morning during the 6 postoperative months. The patients were discharged on the 4th postoperative day with oral analgesic treatment prescription. Until postoperative 3rd day, rehabilitation was performed in the orthopedic clinic of the hospital and then was continued in the physical therapy unit for the following 12 days under the supervision of physiotherapists. Patients' compliance with rehabilitation was controlled by the daily physical therapy outpatient clinic secretariat.

The rehabilitation program was carried out 6 times a week with 1 session a day per patient except for Sundays. For Sundays, a home exercise program was prescribed for patients, and the patients were asked to verbally confirm if they were doing home exercises.

The rehabilitation program went on from the first day after surgery until the 15th day (first 3 days in the hospital with a physiotherapist next 12 days in a

physical therapy outpatient with a physiotherapist). This program contains the following exercise regime: passive and active ROM exercise, isometric exercises for gluteal, quadriceps muscles and straight leg lift of operated extremity, ankle pump exercise. On the first day, the ROM exercise was performed passively, accompanied by continuous passive motion machine (CPM) with 40 degrees of flexion. In the next 2 days in the hospital, 60 degrees of flexion was attempted to be reached with CPM. During physiotherapy at the physical therapy clinic, CPM was not used and the patient was asked to perform knee flexion for as long as they could withstand the pain. Patients were asked to give full weight bearing from the first day after surgery.

After the rehabilitation program in the hospital was completed, the 6-month home exercise program including ROM and strengthening exercises for hip and knee muscles were prescribed for all patients. After 6 months, patients were instructed to visit the clinic for measurements.

All patients were evaluated physically and mentally with SF-36 short form[20], TSK[18], Visule Analogue Scale (VAS), range of motion (ROM), and 2-minute walk test (2MWT)[21] before the operation and at the sixth postoperative month. All scores and objective measurements were performed by an independent blinded physiotherapist.

Statistical Analysis

Statistical analyses were carried out using IBM SPSS (v 15.0; Chicago, IL, USA). Shapiro-Wilk test was used to confirm normal distribution of the data. Mean and standard deviation, and median and min-max values for continuous data, and percentage and number values for qualitative data were reported as descriptive statistics.. Independent samples t-test or Mann-Whitney U test were used in group comparisons depending on the normal distribution of the data. The paired groups t-test or Wilcoxon two-co-tests were used to compare the preoperative and postoperative evaluations. $p < 0.05$ was set as statistically significant level.

RESULTS

While each group initially consisted of 30 patients, three patients (%6) in group A and two patients (%4) in group B could not be reached at the follow-up period. They were excluded from the study since they did not attend the physiotherapy clinic after the surgery. Therefore, 27 patients in group A and 28 patients in group B were evaluated in this study. The follow-up time of all patients was 24 ± 1 weeks due to physical and mental evaluation of all patients before surgery and at the 6th month after surgery.

The mean age of the patients in the study group was 63.91 ± 2.5 and their K / E ratio was 38/9. In the control group, the mean age of the patients was 62.67 ± 1.5 and the K / E ratio was 37/11.

TSK score

TSK score did not change in either of the groups. In addition, there was no difference between the groups in terms of preoperative and postoperative TSK score. (Table I).

Quality of life

According to the comparative results of SF-36 short form before and after treatment for the study (video) group, there were statistically significant differences in all scores except SF-Emotional well-being (Table II). When comparing the preoperative and postoperative results based on SF-36 scores in the control group, only SF-Role limitations due to physical health and SF-Role limitations due to emotional problems

Table I. — Demonstrating change in groups and comparing groups in terms of ROM, 2MWT, TSK, VAS tests.

	Groups	Preoperative	Postoperative	p value
Knee flexion angle	Group A	95,6°±7,5	125,94°±8	p<0,001*
	Group B	97±9,7°	111,6°±6,9°	p<0,05*
	Comparison of Groups	p=0,127	p<0,05*	
2MWT score (step)	Group A	68,2±18,6	92,4±17,9	p<0,001*
	Group B	68,3±10,3	92,2±5,5	p<0,001*
	Comparison of Groups	p=0,073	p=0,069	
TSK score	Group A	44,82±3,5	43,55±3,2	p=0,214
	Group B	46,11÷3,1	45,78±3,4	p=0,195
	Comparison of Groups	p=0,405	p=0,3112	
VAS score	Group A	7,5±0,5	0,8±0,1	p<0,001*
	Group B	7,15±1,3	2,3±0,8	p<0,001*
	Comparison of Groups	p=0,36	p<0,05*	

Table II. — Pre- and Post-Treatment Comparison for Group A (Study Group) based on SF-36 scores.

	Pre-Treatment	Post-Treatment	
	M±SD Median (Min-Max)	M±SD Median (Min-Max)	p
SF-Physical functioning	75.2±16	92.5±20.2	0.004*
SF-Role limitations due to physical health	0 (0-100)	75 (0-100)	0.001*
SF-Role limitations due to emotional problems	32.3 (0-100)	65.7 (0-100)	0.003*
SF-Energy/fatigue	45.3±18.3	58.4±17.8	0.004*
SF-Emotional well-being	63±13.5	64.7±14.5	0.382
SF-Social functioning	75 (12.5-100)	80.8 (50-100)	0.001*
SF-Pain	48.3±22.7	78.5±16.8	<0.001*
SF-General health	54.2±17	59.8±16.5	0.004*

Table III. — Pre- and Post-Treatment Comparison for Group B (Control Group) based on SF-36 scores.

	Pre-treatment	Post-treatment	
	M±SD Median (Min-Max)	M±SD Median (Min-Max)	p
SF-Physical functioning	76.5±17	83.5±19.5	0.561
SF-Role limitations due to physical health	25 (0-100)	50 (0-100)	<0.001*
SF-Role limitations due to emotional problems	15.5 (0-100)	32.4 (0-100)	0.037*
SF-Energy/fatigue	45.7±20.6	47.4±14.5	0.674
SF-Emotional well-being	58±17.2	56.7±9.7	0.920
SF-Social functioning	58.2 (25-100)	55.2 (37.5-87.5)	0.427
SF-Pain	39.2±19.2	45±14.8	0.083
SF-General health	50.1±13.6	46.5±8	0.583

scores showed statistically significant differences (Table III). In the beginning, there was no statistically significant difference between study and control groups regarding the SF-36 score results. After the treatments, there were statistically differences in all scores between video and control groups except for SF-Role limitations due to emotional problems and SF-Role limitations due to physical health scores (Table IV).

VAS score

Improvement in subjective pain was statistically significant in both groups. However, no difference was found in the comparison of preoperative VAS values between the groups (p=0,36), while the improvement in the VAS score of the study group in the 6th month was significantly higher than the control group (p <0.05) (Table I).

ROM

The increase in ROM was statistically significant in both groups. When comparing the groups, there was no statistical difference between the preoperative ROM (p=0,1279) However, in terms of postoperative ROM in the 6th month, there was a statistically significant improvement in the video group compared to the control group (Table I).

Functional score

The improvement in 2MWT was statistically significant in both groups. There was no difference in comparison of the 2MWT values of the groups neither before the surgery nor at the 6th month (Table I).

DISCUSSION

The most important finding of this study is that the rehabilitation program including visualization of the patient's own video did not reduce kinesiophobia level during rehabilitation but improved the ROM, quality of life and decreased the VAS in patients who underwent TKA.

Kinesiophobia is defined as the urge which prevents physical activity due to fear of pain[9]. Previous studies have shown that kinesiophobia directly affects the outcomes of orthopedic surgeries[4,7,22-24]. For example, Kocic et al.[22] examined the possible relationship between kinesiophobia and TKA outcomes. They showed that kinesiophobia occurred in a significant proportion of patients following TKA surgery. They further reported that kinesiophobia was associated with knee pain, flexion, and functional outcomes[22]. Moreover, more than 20% of the patients reported kinesiophobia after the TKA surgery. On the study

Table IV. — Comparison of Groups Regard to SF-36 scores.

	Group A (Study group)(n=27)	Group B (Control group)(n=28)	p
	M±SD Median (Min-Max)	M±SD Median (Min-Max)	
PRE-SF-Physical functioning	75.2±16	76.5±17	0.835
PRE-SF-Role limitations due to physical health	0 (0-100)	25 (0-100)	0.421
PRE-SF-Role limitations due to emotional problems	32.3 (0-100)	15.5 (0-100)	0.389
PRE-SF-Energy/fatigue	45.3±18.3	45.7±20.6	0.387
PRE-SF-Emotional well-being	63±13.5	58.0±17.2	0.094
PRE-SF-Social functioning	75 (12.5-100)	58.2 (25-100)	0.320
PRE-SF-Pain	48.3±22.7	39.2±19.2	0.078
PRE-SF-General health	54.2±17	50.1±13.6	0.193
POST-SF-Physical functioning	92.5 (20-100)	83.5 (20-95)	0.008*
POST-SF-Role limitations due to physical health	75 (0-100)	50 (0-100)	0.147
POST-SF-Role limitations due to emotional problems	65.7 (0-100)	32.4 (0-100)	0.092
POST-SF-Energy/fatigue	58.4±17.8	47.4±14.5	0.008*
POST-SF-Emotional well- being	64.7±14.5	56.7±9.7	0.018*
POST-SF-Social functioning	80.8 (50-100)	55.2 (37.5-87.5)	0.002*
POST-SF-Pain	78.5 (22.5-100)	45 (22.5-77.5)	<0.001*
POST-SF-General health	59.8±16.5	46.5±8	0.003*

of patients undergoing TKA surgery, Doury et al.[23] compared the patients with and without kinesiophobia in through a 6-minute walk test. They found that walking distance of patients with kinesiophobia was significantly shorter than that of patients without kinesiophobia[23]. They further showed that kinesiophobia adversely affected the functional recovery following the surgery. Deniz et al.[24] investigated the effect of kinesiophobia on early functional outcomes and pain after TKA surgery. In their study, they divided the patients into two groups based on TSK score: high kinesiophobia (TSK> 39.5) and low kinesiophobia (TSK < 39.5). In the group with low kinesiophobia, 2-minute walk test, ROM and pain were found to be better compared to those of the highly kinesiophobic group. Therefore, they achieved better functional outcomes in the early period for the group with low kinesiophobia[24]. Similarly, Filardo et al.[7] investigated the effects of kinesiophobia on the outcomes of TKA surgery at postoperative fifth day and first, sixth, and twelfth months. In their studies evaluating kinesiophobia with TSK score, they showed that kinesiophobia was strongly associated with both postoperative acute pain and recovery up to postoperative 1 year. They also reported that a higher level of kinesiophobia would lead to poor clinical outcomes following TKA surgery[7]. In a similar manner, the mean kinesiophobia levels of the patients in our study were similar in both groups when TSK values were higher than 39.5 (Group 1 TSK = 44.82 ± 3.5 and Group 2 TSK = 46.11 ± 3).

To the best of our knowledge, there have been only three studies investigating a way to reduce kinesiophobia after the TKA surgery[4,14,25]. Among these three studies, Cai et al.[4] compared the outcomes after the surgery between the patients who underwent rehabilitation program based on cognitive behavioral therapy (CBT) and the patients who underwent standard rehabilitation program. The aim of using CBT in the study was to reduce kinesiophobia which may in turn reduce pain and improve knee function. They reported that CBT-based rehabilitation involving four sections (1=Kinesiophobia analysis, 2=Kinesiophobia training, 3=Progressive muscular relaxation, and 4=Graded knee functional rehabilitation exercise) resulted in reducing kinesiophobia and increasing knee function compared to standard rehabilitation[3] . In the second study, Russo et al.[14] also investigated the effect of showing videos to patients in early recovery following TKA surgery. The study in which a video was used to enhance the patient's self-confidence and provide psychological support showed better improvement in early clinical and functional outcomes with the patients who watched the encouraging video compared to those who did not[14]. In the third study, Brown et al.[25] investigated the possible relationship between TSK score and ROM after primary TKA surgery along with the effect of postoperative photograph of the patient's own knee on ROM. Based on their results, they concluded that TSK may be used as a tool for surgeons to identify the patients at risk for

non-adherent responses to painful stimuli, and may be used by arthroplasty surgeons to identify patients with decreased ROM risk after TKA[25]. They further reported that showing a clinical photograph of the knee to the patients was not effective in increasing ROM after TKA surgery[25]. With the same purpose, instead of a photograph, the visual stimulation used in our study to reduce kinesiophobia was a video of the patient's complete range of motion of the operative knee and identification of the patient's face. Unlike the visual stimuli used in the study of Brown et al.[25] our visual stimulus included the full extension and flexion of the joint along with the knowledge that the video belongs to the patients knee. Furthermore, the effect of visual stimulation on reducing kinesiophobia and functional outcomes of surgery in our study was evaluated not only with ROM but also with 2-minute walk test, TSK and VAS pain score. Our cumulative results suggested that visual stimulation doesn't effect kinesiophobia level but improves VAS, SF-36 values and increases ROM in contrast to the findings of Brown et al[25].

More recently, Guanzhen Lu and colleagues investigated the effect of micro-visual intervention

in patients with high kinesiophobia who underwent total knee arthroplasty during the Covid 19 pandemic. In this study, they stated that micro-video reduced the scores of fear of movement and pain in patients with high kinesiophobia who underwent unilateral total knee prosthesis, increased the joint range of motion, and provided a rapid return to daily life[26].

Our study also has some limitations. This study was conducted in a single center and included only patients with high TSK scores. Therefore, the findings herein may not be generalized to the general population. Another limitation was that only kinesiophobia was investigated in the study while other psychological, physical or socio-economic factors were not considered. Moreover, early outcomes after TKA surgery were investigated in our study. Therefore, a future study investigating possible long-term outcomes is still needed.

Our results suggest that the rehabilitation performed with the help of the video as a visual stimulus is not effective in decreasing kinesiophobia. The results of the study also showed us that using the patients own video as a visual stimulus in patients undergoing TKA surgery is effective in increasing range of motion, and reducing pain level. Such rehabilitation procedure has a significant effect on the improvement of functional outcomes and quality of life in patients who have undergone TKA with high kinesiophobia levels compared to those who underwent standard rehabilitation procedure. The findings of this study also suggest that the use of visual stimulus video during rehabilitation can contribute to home rehabilitation by encouraging the patient out.

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