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Research Article

The Impact of Cognitive Behavioral Therapy on Kinesiophobia and Rehabilitation After Total Knee Replacement

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Abstract

Osteoarthritis is a leading cause of disability, and total knee replacement (TKR) is a common treatment for severe cases. However, recovery is often hindered by kinesiophobia, a fear of movement affecting many patients. This randomized controlled trial (RCT) evaluated the impact of Cognitive Behavioral Therapy (CBT) on kinesiophobia and rehabilitation outcomes in TKR patients. A total of 105 participants were randomly assigned to either a CBT group or a control group receiving standard care, with randomization conducted using a computer-generated allocation sequence and sealed envelopes. The CBT intervention included four tailored sessions addressing kinesiophobia through education, progressive muscle relaxation, and graded functional exercises. Outcomes were assessed at baseline, 6 weeks, and 12 weeks post-intervention. The primary outcome was kinesiophobia, measured by the Tampa Scale for Kinesiophobia (TSK), while secondary outcomes included pain, disability, and quality of life. Results demonstrated that the CBT group had significantly reduced kinesiophobia and improved functional outcomes compared to the control group. These findings support CBT as an effective intervention for enhancing recovery and reducing psychological barriers in TKR patients.

Keywords: Cognitive Behavioral Therapy; Kinesiophobia; Total Knee Replacement; Rehabilitation; Tampa Scale for Kinesiophobia

Abbreviations

TJR: Total Joint Replacement Surgery; THR: Total Hip Arthroplasty; CBT: Cognitive Behavioral Therapy; TSK: Tampa Scale for Kinesiophobia

Introduction

Osteoarthritis of the large joints is one of the leading causes of pain and disability, with 2.5 million people affected globally. Patients who have failed conservative medical treatment with the most severe symptoms of arthritis are considered for total joint replacement surgery (TJR) as the treatment of choice. Among TJRs, Total Knee Arthroplasty (TKR) and Total Hip Arthroplasty (THR) are the two most widely practiced surgeries for arthritis worldwide. Nearly 1.2 million TJR procedures are reported annually for primary total knee arthroplasty worldwide. Between 2000 and 2019, the estimated annual volume of THA increased by 177% and that of TKA increased by 156% on average [1,2]. In this way, TJRs can be considered a surrogate marker of severe osteoarthritis.

Knee osteoarthritis represents a four-fifth proportion of the global burden of osteoarthritis. Despite advances in surgical orthopedic techniques, approximately 20% of TKR patients do not report improved pain levels, physical functioning, or quality of life. Moreover, many patients (20%-50%) continue to experience functional disability [3]. There is a possibility that all these factors collectively involved in the TJRs may have an impact on psychological well-being at an interindividual and intraindividual level [4].

Kinesiophobia has been found to have a major influence on the post-acute and chronic phases of recovery from an injury or illness. This fear of movement can potentially hinder the long-term success of rehabilitation efforts [5]. Still, it has also been a significant predictor of chronic pain persisting for more than 3 months [6].

A systematic review by Oliver S. Brown in 2020 evaluated 13 studies to find the relationship between Kinesiophobia and functional outcomes, pain and range of motion following TKR. It also assessed published treatments for Kinesiophobia resulting from TKR. They found that kinesiophobia negatively affects functional outcomes up until 1 year post-operatively, while active ROM is reduced up to 6 months post-procedure. Post-operative functional and psychological interventions can improve Kinesiophobia following TKR [7].

To address this issue, Cognitive Behavioral Therapy (CBT) has been suggested to effectively manage Kinesiophobia. Studies have demonstrated that CBT programs have reduced Kinesiophobia and improved disability, pain, and quality of life in patients with chronic low back pain and total knee replacement [8]. Additionally, a clinical Pilates exercise program has also been effective in reducing Kinesiophobia, pain, and functional status [9].

This study hypothesizes that a structured CBT program can effectively reduce kinesiophobia and enhance physical rehabilitation outcomes in patients undergoing TKR surgery. The primary aim of this research is to evaluate the efficacy of a CBT-based intervention in reducing kinesiophobia compared to standard care. Secondary aims include assessing improvements in pain management, physical function, and overall quality of life. By addressing both psychological and physical barriers to recovery, this study seeks to provide evidence supporting the integration of CBT into post-operative care for TKR patients.

Materials and Methods

Study design

This is a double-blinded, randomized, parallel-group, controlled, superiority pilot trial conducted from June 2022 to June 2023 at the ANUP Orthopedics and Rehabilitation Department. The study design was approved by the Ethical Committee of our institution (No: 026/2015).

Study participants

Participants in this study were patients who had undergone unilateral TKR surgery due to knee osteoarthritis. After the surgery, they were screened at the hospital using the Tampa Scale for Kinesiophobia (TSK) to determine whether they exhibited high levels of kinesiophobia, defined by a TSK score greater than 37. Patients who met all inclusion criteria were invited to participate. Eligible participants were required to be 18 years of age or older, able to read, speak, and understand the local language (Bihari/ Hindi), and willing to provide written informed consent indicating their agreement to participate in the research and adhere to the treatment protocol and follow-up visits. Individuals with a history of prior knee surgery, scheduled for revision knee arthroplasty, or diagnosed with venous thromboembolism, neurological disorders, psychiatric or psychological conditions, or those who had previously participated in a CBT intervention, were excluded from the study. Participants who met the inclusion criteria were randomly assigned to a treatment group and completed all follow-up visits as part of the study protocol.

Experimental procedure

Following the consent of each patient, an independent statistician unfamiliar with the study patients randomly assigned each patient to a treatment program based on blinded treatment codes and an automatic allocation system through concealed group assignments. A primary goal of this CBT program was to reduce kinesiophobia and psychological distress to reduce pain and disability. After TKR surgery, a physiotherapist and a psychologist delivered a CBT program that included four individually tailored sessions. There were approximately 30 minutes in each session. Following are the details of the four sessions.

Session 1-Person-centered analysis of kinesiophobia

This session was designed to analyze factors responsible for kinesiophobia. On the first or second day following TKR surgery,

the physiotherapist discussed with the patients what physical activities they wished to perform. The patients were asked to list physical activities they had recently stopped performing due to kinesiophobia after TKR but would like to resume doing. A daily activity goal was then established for the patients by selecting one of these physical activities. A questionnaire assessment was used to identify psychological risk factors associated with kinesiophobia. A TSK, BSI, WOMAC and SF-36 Scale questionnaire was administered to patients before session 2.

Session 2-Kinesiophobia education

Once the patients completed the questionnaires in session 1, they participated in an individual education program aimed at modifying their kinesiophobia beliefs and pain catastrophizing under the supervision of a clinical psychologist. A psychologist guided the patients in a discussion about feelings, beliefs, and knowledge about staying active despite kinesiophobia 3-4 days after TKR surgery. A variety of topics were presented, including sleep hygiene, daily exercise, cognitive reconstruction, stress reduction, and energy management. In addition to the booklet with information about kinesiophobia management, patients also received cognitive training to minimize activity-related problems. As a result of this information, patients were able to manage kinesiophobia rather than treat it as a serious disease that required careful and vigilant attention [8].

Session 3- Progressive muscular relaxation

The session aimed to improve patients' self-efficacy, crucial to staying active despite pain and teaching rapid relaxation in risky situations. Four weeks after TKR surgery, each patient received 20-30 minutes of progressive muscular relaxation every two days. A psychologist instructed patients to relax their muscles in a psychological counselling room by lying in a comfortable bed, including their hands, legs, shoulders, and other muscles [10,11]. Patients were then taught how to realize their feelings, cognitive abilities, and behaviour associated with their daily activities after having TKR surgery by the psychologist.

Session 4- Graded knee functional rehabilitation exercise

During this session, patients were exposed to situations they had previously identified as dangerous in order to help them transfer their attention from kinesiophobia to knee functional rehabilitation exercises. In the first 1-2 days following TKR surgery, patients were guided by the physiotherapist in graded knee functional exercises. As soon as the patient has achieved their short-term goal, the goal will be modified by increasing the duration, intensity, or frequency of the physical activity or by selecting a different activity from the list of activities established during session 1 [12,13].

Standard care was provided to the control group at the ward. These patients received standardized information, including postoperative routines, pain management and rehabilitation exercises based on TKR patients in general. The rehabilitation exercises included using walking aids during early walking, functional task-oriented exercises, such as moving climbing obstacles, and weight-bearing exercises, such as walking in place and bilateral and unilateral knee flexion when standing. All the standardized information was included in a booklet given to all patients for future reference. All patients in the two groups were asked to avoid any additional treatments (e.g., physical modalities, massage) and were advised to stay active daily and to contact the physiotherapist twice a week for their future daily rehabilitation exercises after discharge from the hospital.

Data collection and analysis

The data were collected at three time points: before intervention (1^{st} or 2^{nd} day after the TKR procedure), six weeks after intervention (post-intervention), and 12 weeks after the treatment ended (follow-up). All measurements were performed by an independent investigator who was blinded to the group assignment. The physiotherapist who helped patients with rehabilitation exercises was also blinded to the intervention to avoid the introduction of potential bias. Patients in the experimental group knew they were receiving CBT intervention but did not know the content of the intervention in the control group, and they were asked not to discuss any study procedures with the research personnel. In addition, the psychologist was blinded to the aims and hypotheses of the study.

The sociodemographic questionnaire was administered, followed by the BSI, WOMAC, and SF-36 Scale questionnaires. Kinesiophobia was measured by the Simplified Chinese version of the Tampa Scale for Kinesiophobia (SC-TSK). The scale includes 17 items, answered on a 4-point Likert scale ranging from strongly

disagree to agree strongly. The item scores are summed to create a total score ranging between 17 and 68 points, with a higher score indicating a stronger perceived level of kinesiophobia [14]. A TSK value greater than 37 as a cut-off point for kinesiophobia was originally proposed by Vlaeyen [15]. Later, Lundberg [16] concluded that a TSK value greater than 40 indicates kinesiophobia. The cut-off kinesiophobia score for our study was set at 37 based on Chinese research [17]. Then, the TSK was linguistically translated and culturally adapted, and the meaning of the original version was sufficiently maintained by idiomatic translation. The TSK has been translated into many languages [18,19], showing acceptable internal consistency. The SC-TSK has shown good content validity and reliability among older people, with high test-retest reliability (intraclass correlation coefficient [ICC] = 0.86) and internal consistency (Cronbach's alpha= 0.74) [20].

Statistical analysis

The sample size was calculated according to the method described by Charan and colleagues [21]. The sample size for this trial was based on the primary outcome TSK score. A sample size of 50 patients per group was calculated as capable of detecting a minimum clinically important difference in kinesiophobia between groups of 8 points in the primary outcome with a statistical power of 80% and a type I error of 5%. Mean and standard deviation (SD) were used to describe continuous variables, and frequency distributions were used for categorical variables. A univariate analysis, consisting of the Chi-squared test for categorical variables and Student's t-test for continuous variables, was conducted to compare the differences in variables to investigate the relationship of proposed risk factors of participants with or without kinesiophobia. Multivariate logistic regression analysis was performed to assess the factors associated with kinesiophobia. The inclusion and exclusion thresholds for the variables were 0.05 and 0.10, respectively. SPSS software version 21.0 (IBM Corp., Armonk, NY, USA) was used for statistical analyses. For all analyses, *p*-value <0.05 was considered statistically significant.

Results and Discussion

A total of 186 patients underwent knee replacement surgery during the study period. Among them, 142 were found eligible for the study and accepted to participate in the study. Among 142, 105 (74%) patients were identified to have kinesiophobia after surgery with a TSK score above 37 points. Hence the final study included 105 patients. The baseline characteristics of participants in the study were examined, comparing those who underwent CBT (n = 50) with a Usual care group (n = 55). Significant differences were observed between the two groups across various demographic, psychosocial, and clinical variables (Table 1).

	CBT (n = 50)	**Usual care (n = 55)**	***p*-value**
Age	60 (10.1)	58 (6.3)	<0.001
Gender			
Male	16 (32%)	19 (34.5%)	<0.001
Female	34 (68%)	36 (65.5%)	
Education n (%)			
Educated	21 (42%)	26 (47.3%)	
Uneducated	25 (50.0%)	20 (36.4%)	<0.001
Unknown	4 (8.0%)	9 (16.4%)	
Living condition n (%)			
Living with partner	27 (54.0%)	21 (38.2%)	
Living with children	21 (42.0%)	32 (58.2%)	<0.001
Single	2 (4.0%)	2 (3.6%)	
Occupation n (%)			
Working	23 (46.0%)	12 (21.8%)	
Not working	9 (18.0%)	26 (47.3%)	<0.001
Others	18 (36.0%)	17 (30.9%)	
TSK score Mean (SD)	22.56 (3.26)	22.36 (3.51)	<0.001
BSI score Mean (SD)			
BSI Somatization	6.26 (3.28)	7.00 (3.283)	<0.001
BSI Depression	7.58 (4.18)	6.09 (3.62)	
BSI Anxiety	7.18 (3.25)	9.42 (4.31)	
WOMAC score Mean (SD)			
WOMAC Pain	19.2 (4.88)	19.88 (4.94)	
WOMAC Stiffness	2.78 (2.34)	3.07 (2.59)	<0.001
WOMAC Physical Function	40.0 (11.86)	41.40 (12.60)	

SF- 36 score Mean (SD)			
SF36-PHS	2.77 (1.19)	2.81 (1.40)	<0.001
SF36-MHS	3.57 (1.62)	4.88 (2.17)	

Table 1: Baseline sociodemographic details of TKR patients with kinesiophobia.

CBT: Cognitive Behavioral Therapy; Usual Care; TSK: Tampa Scale of Kinesiophobia; AV: Action Avoidance; SF: Somatic Focus; SD: Standard Deviation

Paired Samples t-tests were conducted to examine changes in the BSI scores over time for both the CBT and usual care groups, as presented in table 2 and figure 1. The results of the study showed that the CBT group and the Usual Care group both experienced statistically significant improvement in psychological scores (BSI, TSK, and SF-36 scores) throughout the study, and both groups experienced statistically significant physical function scores (WOMAC, SF-36 scores).

Type of joint replacement surgery Mean (SD) Std. Error Mean			**Paired Differences**				**t**	***p*-value**
			95% CI of the Difference					
			Lower	**Upper**				
BSI Somatization	CBT	T0-T1	4.28 (3.02)	0.42	3.42	5.19	10.0	<0.001
		T0-T2	5.94 (3.16)	0.44	5.04	6.83	13.27	<0.001
	Usual care	T0-T1	4.43 (2.19)	0.29	3.84	5.02	15.00	<0.001
		T0-T2	6.67 (2.93)	0.39	5.87	7.46	16.84	<0.001
BSI Depression	CBT	T0-T1	5.80 (4.37)	0.61	4.55	7.04	9.34	<0.001
		T0-T2	7.30 (4.15)	0.58	6.11	8.41	12.41	<0.001
	Usual care	T0-T1	4.09 (2.32)	0.31	3.46	4.72	13.03	<0.001
		T0-T2	5.80 (3.24)	0.437	4.924	6.676	13.27	<0.001
BSI Anxiety	CBT	T0-T1	5.42 (3.27)	0.463	4.489	6.351	11.69	<0.001
		T0-T2	6.98 (3.23)	0.458	6.060	7.900	15.25	<0.001
	Usual care	T0-T1	6.18 (2.96)	0.400	5.381	6.983	15.47	<0.001
		T0-T2	8.7 (3.83)	0.517	7.744	9.819	16.97	<0.001
WOMAC Pain	CBT	T0-T1	9.26 (5.58)	0.78	7.67	10.84	11.73	<0.001
		T0-T2	13.2 (4.61)	0.65	11.94	14.57	20.31	<0.001
	Usual care	T0-T1	9.43 (6.04)	0.81	7.80	11.07	11.57	<0.001
		T0-T2	13.27 (6.14)	0.82	11.61	14.93	16.01	<0.001
WOMAC Stiffness	CBT	T0-T1	2.06 (2.73)	0.38	1.28	2.83	5.32	<0.001
		T0-T2	2.16 (2.58)	0.36	1.42	2.89	5.91	<0.001
	Usual care	T0-T1	2.56 (2.78)	0.37	1.81	3.31	6.82	<0.001
		T0-T2	2.56 (2.90)	0.39	1.77	3.34	6.54	<0.001
WOMAC Physical function	CBT	T0-T1	20.7 (13.0)	1.85	17.05	24.50	11.21	<0.001
		T0-T2	33.3 (12.42)	1.75	29.76	36.83	18.94	<0.001
	Usual care	T0-T1	17.67 (11.89)	1.60	14.45	20.88	11.02	<0.001
		T0-T2	34.16 (13.86)	1.87	30.41	37.91	18.26	<0.001

TSK scores	CBT	T0-T1	8.18 (3.97)	0.56	7.05	9.30	14.55	<0.001
		T0-T2	20.74 (3.76)	0.5	19.66	21.81	38.95	<0.001
	Usual care	T0-T1	1.9 (2.62)	0.35	1.18	2.6	5.36	<0.001
		T0-T2	19.5 (4.44)	0.59	18.30	20.71	32.53	<0.001
SF 36 Physical function	CBT	T0-T1	-14.35 (2.90)	0.41	-15.17	-13.52	-34.95	<0.001
		T0-T2	-21.04 (4.86)	0.68	-22.42	-19.66	-30.58	<0.001
	Usual care	T0-T1	-14.57 (2.92)	0.39	-15.37	-13.78	-36.92	<0.001
		T0-T2	-18.38 (5.62)	0.75	-19.91	-16.86	-24.22	<0.001
SF 36 Mental Function	CBT	T0-T1	-7.22 (2.82)	0.39	-8.02	-6.42	-18.11	<0.001
		T0-T2	-5.27 (2.54)	0.36	-5.9	-4.54	-14.62	<0.001
	Usual care	T0-T1	-10.6 (2.73)	0.36	-11.40	-9.92	-28.86	<0.001
		T0-T2	-5.60 (3.95)	0.53	-6.67	-4.53	-10.51	<0.001

Table 2: Changes in Physical and mental scores over three follow-up times in CBT and usual care patients.

CBT: Cognitive Behavioral Therapy; Usual Care; TSK: Tampa Scale of Kinesiophobia; AV: Action Avoidance; SF: Somatic Focus; SD: Standard Deviation

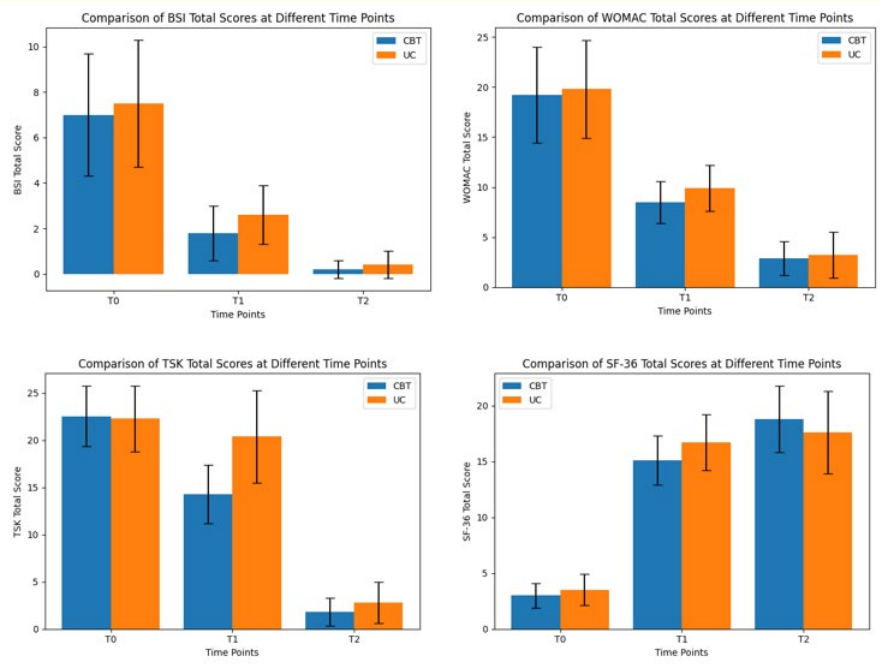

Figure 1: Changes in Physical and mental scores over three follow-up times.

ANOVA results in Table 3 indicate that CBT in the group was able to reduce psychological distress symptoms (BSI Scores) severity at T1 ($p < 0.001$). Although no significant differences existed between the CBT and Usual Care groups at the other two time points, this effect may not last over time. In addition, the WOMAC mean scores of the CBT and Usual Care groups differed significantly at T1 ($p < 0.001$), but not at T0 or T2. As for the SF36 Physical Health mean scores, T2 significantly differed from T0 and T1, while there was no difference between T0 and T1. Surprisingly, SF36 Mental Health mean scores were significantly different at all three points between groups that received CBT versus usual care ($p < 0.001$). The Usual Care group had significantly higher mean scores at T1 and T2, indicating better mental health outcomes than the CBT group. However, at T0, the CBT group had significantly higher mean scores, indicating better mental health outcomes at baseline. The significant differences at different times imply that the effects of treatments on mental health outcomes may vary over time.

The most important finding of this randomized controlled trial with a 12-month follow-up was that a program based on CBT was superior to standard usual care in reducing knee pain intensity and in enhancing knee function in patients following TKA.

At baseline, 105 (74%) of 142 eligible subjects had kinesiophobia on the TSK scale (TSK>37 points), with a mean score of 22.45 (3.3).

	Between the groups				
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
TSK T0	1.01	1.00	1.01	0.09	0.77
TSK T1	969.33	1.00	969.33	55.3	<0.001
TSK T2	28.03	1.00	28.03	7.27	0.01
BSI T0	6.45	1.00	6.45	0.80	0.37
BSI T1	15.13	1.00	15.13	8.52	<0.001
BSI T2	0.60	1.00	0.60	2.19	0.14
WOMAC T0	12.28	1.00	12.28	0.51	0.48
WOMAC T1	58.45	1.00	58.45	11.63	<0.001
WOMAC T2	1.75	1.00	1.75	0.41	0.52
SF 36 PFS T0	0.06	1.00	0.06	0.04	0.85
SF 36 PFS T1	2.01	1.00	2.01	0.25	0.62
SF 36 PFS T2	178.28	1.00	178.28	7.07	0.01
SF 36 MFS T0	45.05	1.00	45.05	12.06	<0.001
SF 36 MFS T1	589.79	1.00	589.79	63.51	<0.001
SF 36 MFS T2	70.81	1.00	70.81	9.89	<0.001

Table 3: Results of ANNOVA to compare difference between the CBT and Usual Care groups.

CBT: Cognitive Behavioral Therapy; Usual Care; TSK Tampa Scale of Kinesiophobia; AV: Action Avoidance; SF: Somatic Focus; SD: Standard Deviation.

Our study showed a higher incidence of kinesiophobia than was found among French patients of TKA (35.96%), Serbian patients (21.79%), Chinese patients (24.4%), and Switzerland (58.2%) [5,22-24]. The different results are likely due to differences in sample size and demographic characteristics of the population evaluated. A kinesiophobia's incidence rate may also be affected by differences in regional and cultural backgrounds. Nevertheless, given the high incidence of kinesiophobia in TKA patients, measures should be taken to reduce it.

Table 1 shows younger individuals with TKR and kinesiophobia are likely to enroll in CBT, perhaps because it aligns with their preferences and needs. A significant gender difference was observed between the two groups (p 0.001). Women outnumbered men in both groups; however, males were slightly more prevalent in usual care. A significant proportion of CBT participants were educated and working individuals than those in usual care. Education and employment may influence how psychological interventions like CBT are understood and accepted by individuals. The study's findings showed a significant improvement in psychological scores over time in both groups.

Results showed that CBT patients had significantly lower levels of kinesiophobia and significantly better physical function than those who received usual care. The findings indicate that CBT can effectively reduce kinesiophobia and improve physical function in TKR patients. The results of our study are consistent with previous studies.

In our study, we found that even a short-term CBT program (lasting four weeks) was effective at achieving positive results. These results suggest that there is a significant difference in WOMAC mean scores between the CBT and Usual Care groups at T1 (4 Weeks). Whereas Birch (2017) found that a physiotherapist-led cognitive behavioral education (CBT) program over five months improved functional outcomes and reduced pain in a group of total knee arthroplasty (TKA) patients [25]. Similarly, Monticone., *et al*. (2013) found that CBT-based programs delivered at home over a six-month period improved quality of life and kinesiophobia in chronic low back pain patients [8]. Oksuz., *et al*. (2017) also conducted a randomized controlled trial (RCT) to determine the effects of a clinical Pilates exercise program on kinesiophobi. They found that it improved kinesiophobia, pain, and functional status [9]. Jensen., *et al.* (2007) demonstrated that CBT can change catastrophizing beliefs and kinesiophobia [26].

This study indicates that those undergoing TKR surgery may have high levels of psychological distress before their procedure and may suffer from kinesiophobia upon discharge from the hospital. As such, it is important to recognize this psycho-cognitive factor and its potential role in the recovery process of these patients. In order to better understand how kinesiophobia impacts long-term outcomes for patients suffering from TKR, more research is needed. Moreover, psychological interventions can reduce TJR-related distress and kinesiophobia by incorporating them into pre- and post-surgical care plans.

Study limitations

Several limitations should be considered when interpreting this study. First of all, this is a pilot study conducted in one hospital with a small sample of patients suffering from kinesiophobia after TKA surgery. It is therefore unlikely that these findings can be generalized to other demographic populations. Second, this study relied primarily on self-reported measurements. It is possible that the results would have been slightly different if more objective measures had been used. The final limitation is that this study targeted only patients who had TKR surgery, whereas interventions targeting other joint replacement surgery patients may yield different results. Thus, a longitudinal study design is necessary to examine the effect of CBT on kinesiophobia. Future studies should also consider other variables that may play a role in the effectiveness of CBT, such as gender, age, and socioeconomic status. Additionally, further research is needed to evaluate the long-term effects of CBT on kinesiophobia.

Conclusion

In our RCT with a 12-month follow-up, we discovered that a CBT-based program yielded superior results compared to the usual care program for patients with high levels of kinesiophobia following TKA surgery. This study is the first of its kind to evaluate the impact of a CBT program on kinesiophobia among TKA patients in India. Our findings underscore the importance of considering kinesiophobia in both clinical practice and research, especially for enhancing knee function and physical activity in post-TKA patients. We recommend that future studies further investigate the effects of CBT programs on kinesiophobia at various time points using larger sample sizes.

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Conflict of Interest

There are no conflicts of interest.

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