



doi: 10.4103/2221-6189.272854

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Effect of rehabilitation education on pain, knee stiffness and performance difficulty in patients undergoing knee replacement surgery: A randomized clinical trial

Sheyda Atabaki¹, Mansoureh Ashghali Farahani^{2,3✉}, Shima Haghani²

¹Nursing Department, Iran University of Medical Sciences, Tehran, Iran

²Nursing Care Research Center, Iran University of Medical Sciences, Tehran, Iran

³School of Nursing and Midwifery, Iran University of Medical Sciences, Tehran, Iran

ARTICLE INFO

Article history:

Received 5 August 2019

Revision 26 September 2019

Accepted 14 October 2019

Available online 16 December 2019

Keywords:

Knee joint replacement

Pain

Knee stiffness

Performance difficulty

Rehab training

Rehab nurse

ABSTRACT

Objective: To determine the effect of rehabilitation education on pain, knee stiffness and performance difficulty in patients undergoing knee replacement surgery.

Methods: This randomized clinical trial study was performed on 96 patients undergoing knee replacement surgery, who were randomly divided into two groups: the control group and the intervention group, with 48 patients in each group. In the intervention group, the patients received educational intervention in four stages (one day before surgery, 24 h and 48 h later, upon discharge from the hospital. In the control group, only the routine of the hospital was performed. Questionnaires were completed before and 6 weeks after the intervention.

Results: The mean scores of pain, knee stiffness and performance difficulty were significantly decreased in the intervention group ($P=0.01$). Compared to the control group, the intervention group had a better outcome of the illness, including pain, knee stiffness and performance difficulty ($P=0.001$).

Conclusion: Rehabilitation education could be a suitable way to improve the surgical outcomes of patients undergoing total knee replacement.

1. Introduction

Osteoarthritis is a progressive disease that is associated with severe pain throughout people's daily life, followed by muscle weakness, resulting in performance impairment and a decrease in the quality of life of individuals[1]. Knee osteoarthritis is one of the most common causes of disability of all ages. The prevalence of knee osteoarthritis in different countries is estimated to be between 15.4% and 25.4%[2,3]. According to the statistics of Center for Disease Control and Prevention, osteoarthritis in 2014 has hit more than 240 out of every 100 000 people over the age of 90 in the United

States[3]. Knee osteoarthritis is the second most common form of osteoarthritis and a leading cause of disability in the world, with approximately 59% of the population over 65 years suffering from this disorder[4]. Joint resistance is mostly determined by the shape and properties of cartilage and contact surfaces. Articular capsule and muscular connective tissue are factors that cause resistance. Physiological changes can also affect joint resistance. The most important influencing factors are age, muscle mass, gender, muscle strength, connective tissue genetic disorders, heart rhythm, joint

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How to cite this article: Atabaki S, Farahani MA, Haghani S. Effect of rehabilitation education on pain, knee stiffness and performance difficulty in patients undergoing knee replacement surgery: A randomized clinical trial. J Acute Dis 2019; 8(6): 233-238.

✉ Corresponding author: Mansoureh Ashghali Farahani, Nursing Care Research Center, Iran University of Medical Sciences, Tehran, Iran; School of Nursing and Midwifery, Iran University of Medical Sciences, Tehran, Iran
E-mail: mansoureshghalifarahani@gmail.com
Tel: +98-214365223

temperature, and local and systematic pathologic changes[5].

Due to the fact that the knee is an important weight-bearing joint, the knee is more susceptible to osteoarthritis[6]. In accordance with a global consensus, the principle of treatment for osteoarthritis is “maintenance” based on the patients’ symptoms, and non-pharmacological and pharmacological treatments are mainly used in clinic. Non pharmacological-treatments include physiotherapy and exercise training (strength, balance, and deep sense), treatment with axis correction (brace, sole plate, and tape), and weight loss; while pharmacological treatments include analgesics, anti-inflammation, hyaluronic acid injection, glucosamine, and sulfate supplements[7]. All of the above methods have a sedative effect and can delay the course of the disease[8]. Surgical treatment will be performed if the maintenance treatment is not effective[9]. One of the most effective surgical interventions for relieving pain and enhancing performance in advanced stages of degenerative arthritis patients is total knee arthroplasty or total knee replacement (TKR)[10] that is considered as an effective treatment in the final stage of osteoarthritis[11]. TKR can significantly reduce the pain associated with knee osteoarthritis. According to some studies, pain and movement have been improved significantly after knee joint replacement, with 90% of the patients reporting pain relief, improved performance, and better health status in relation to postoperative quality of life. However, 85% of patients with TKR complained of postoperative outcomes[12]. Rehabilitation education, as an important part of the rehab program, aiming at increasing the awareness of TKR and reducing the anxiety of patient, can play a decisive role in the rehabilitation process. Patient education could improve the prognosis, especially help patient to commitment to the medical recommendations, increase patients’ satisfaction, enhance patient-centered care and patients’ independence, help patient to make healthy lifestyle choices[13]. In this regard, the research by Ben-Morderchai *et al.* suggested that failure to provide post-operative training to TKR patients will lead to poor functional results and subsequently damage the satisfaction of knee joint replacement surgery[14]. Although medical science has progressed over the years, patient education has often been ignored in many medical clinics for material and practical reasons[15]. In some countries, training classes are provided before surgery. Currently, in the United States, knee joint rehabilitation education is provided in more than 490 centers[7]. Several semi-structured interviews with patients under the TKR in German showed that patients were interested in obtaining information about the surgery, recovery and rehabilitation stages[16].

The aim of present study was determine the effect of rehabilitation education on pain, knee stiffness and performance difficulty in patients undergoing knee replacement surgery.

2. Materials and methods

2.1. Study design and registration

This randomized clinical trial study was performed on 96 patients

undergoing knee replacement surgery, who were referred to the orthopedic wards of a hospital in Tehran from July to December 2017. This study was approved by the Ethics Committee in Medical Sciences University of Iran (ethics code: IR.IUMS.FMD.REC 1396.9311689001) and the hospital where the study was conducted. The protocol of the study was registered at Iranian Registry of Clinical Trials (No. IRCT20091124002769N6). Verbal informed consent and written consent were provided and this trial was conducted in accordance with the Declaration of Helsinki. The CONSORT checklist was used for the study report[17].

2.2. Participants and eligibility criteria

Participants were in the age of 50-70 years old, who suffered knee osteoarthritis and undergo knee joint replacement. The patients who were recruited in this study should meet the following criteria: (1) Free from psychological problems, and no history of taking psychoactive drugs before and after the surgery (based on the patients’ statements and the diagnosis of physical and mental health by referring to the patient’s medical records); (2) Having no history of joint replacement or surgery on the knee; (3) Body mass index (BMI) lower than 30 kg/m²; (4) Having reading and writing skills (in the case of illiteracy, there should be at least one educated carer who can be involved in the education process). Exclusion criteria included post-surgical infection, reaction to the prosthesis, transferring to ICU after surgery, lack of cooperation during exercises and trainings, and reluctance to continue the study.

2.3. Intervention

The sample sizes in each group were estimated based on the similar study (at 95% confidence level and 80% probability). In the case of minimal clinically important differences, a decrease of 8 numbers in the level of anxiety of patients with knee replacement due to rehabilitation training was considered statistically significant, by calculating for a 10% drop-out rate, 48 individuals were estimated in each group. A total of 96 patients undergoing knee joint replacement were randomly divided into the intervention group and the control groups. Before the treatment, the oral or verbal informed consents from all patients were obtained. In the intervention and control group, the patients completed the questionnaires before the intervention. Then, the patients received educational intervention in four stages (one day before surgery, 24 h and 48 h later, upon discharge from the hospital.

This educational content was devised based on a thorough literature review[8]. The educational pamphlets were prepared using the standard educational guidelines. At first, the written training content was provided to 3 observers and then to 2 physicians who were skilled in TKR surgery and 2 nurses who were experts in training of TKR patients. After confirmation of the training content, the comments and the requested modifications were applied with the help of the supervisor.

The educational intervention was presented as a combination of

lecture, Group discussion, and individual education, questions and answers. In the intervention group, the rehabilitation program was performed one day before surgery and during the hospital stay until discharge. In the control group, only the routine program of the hospital was performed by the nurse after surgery, including standard precautions, physical activity, exercise, and nutrition.

The content of each session was designed based on the patients' need at different stages. During the first 35 min session one day before surgery, the content included familiarization with knee joint replacement surgery, pre-, and post-operative care. During the second session, 24 h after the surgery, the patients did the predicted physical activities. Using the walker and corrected walking techniques, joint exercises in the range-of-motion were trained. In the third session, 48 h after surgery, the exercises was evaluated and adjusted. Moreover, some explanations regarding the suitability of the home environment were presented in this session. Before discharge, education and training were reviewed and feedbacks were obtained. After 6 weeks of finishing the intervention, questionnaires were provided to all patients, and information was collected when patients referred to the clinic (Figure 1).

2.4. Instruments

Demographic questionnaire (age, gender, marital status, and BMI and education level) and The Western Ontario and McMaster Universities Arthritis Index (WOMAC) questionnaire were used to collect data. To assess the pain, knee stiffness and physical performance of the individual, a standard and specific WOMAC questionnaire was used[18]. The questionnaire consisted of 24 questions in 3 fields (pain, stiffness and physical performance of the individual). Then some questions were asked about the severity of pain (5 questions first), stiffness (2 questions) and physical performance (17 questions) in the last 48 h of daily activities. Results were scored in this questionnaire from zero (the minimum level) to four (the maximum level)[19]. With the increasing of the symptoms severity, a higher score is given and the raw score of each field is the sum of the scores of each question. Then the raw score will be converted to 0 to 100. So that the higher the score, more restrictions the patient has[20]. The validity and reliability of this instrument in Iran in 2013 were translated by Ebrahimzadeh *et al.*, and its reliability was verified and approved by Cronbach 0.9[21].

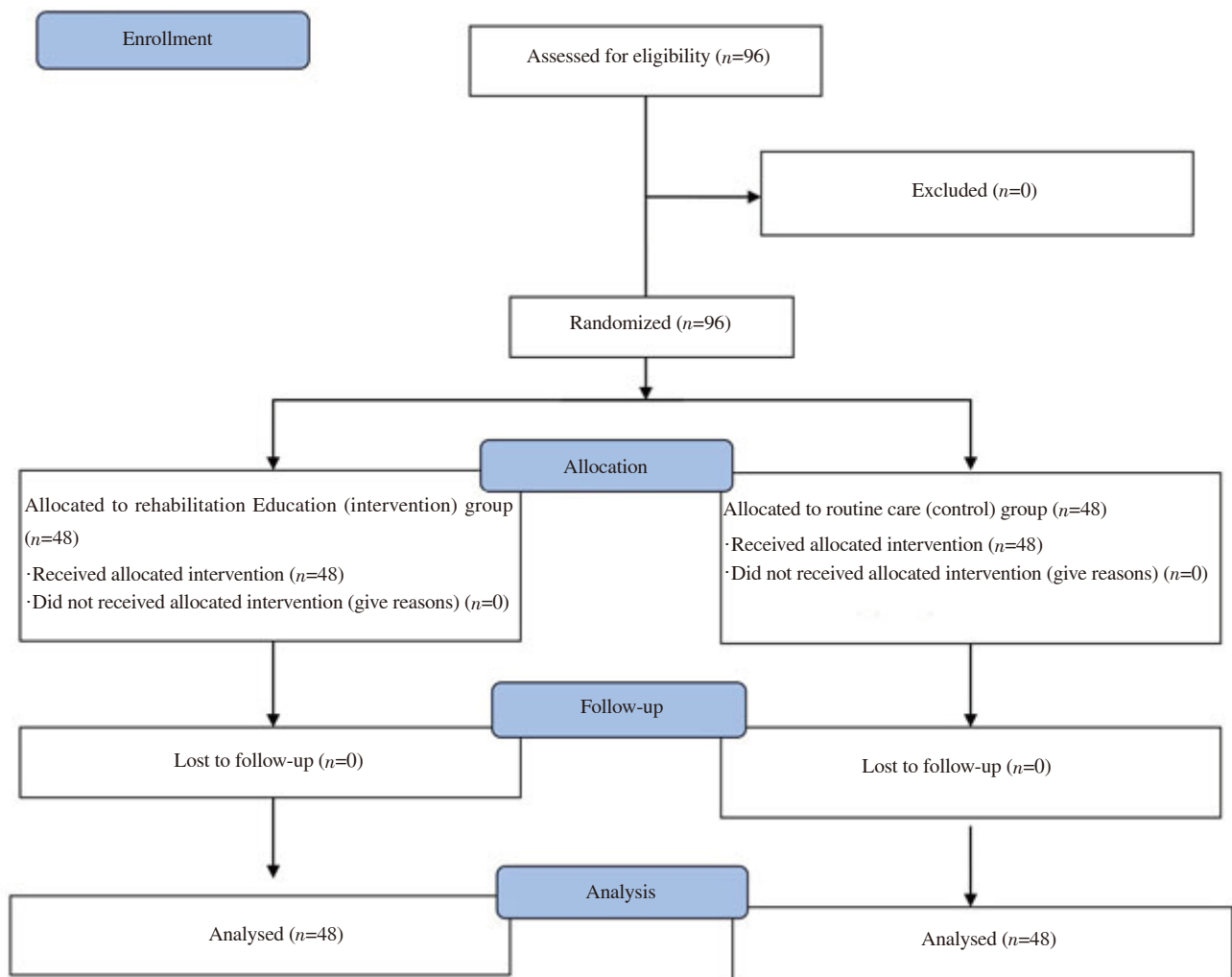


Figure 1. The study flowchart.

2.5. Data analysis

Descriptive tests (frequency, percentage, mean, and standard deviation) were used to describe the demographic characteristics, and statistical tests including *Chi*-square test, independent *t*-test, paired *t*-test, Fisher exact test and covariance test by SPSS version 22 were used to determine the relationship between the main variables.

Independent *t*-test and ANCOVA tests were used to determine the effect of educational intervention on pain, knee stiffness and performance difficulty in patients before and after the educational intervention.

3. Results

3.1. Demographic characteristics

All 96 individuals who were enrolled into the study were randomly divided into two groups (the intervention group and the control group), and all of the participants stayed in the study up to the final stage. The mean age of the intervention group was (65.39±5.08) years and the control group was (63.83±5.14) years. Most participants in the intervention and the control group were married, illiterate, and their BMI was in the range of 30.0-34.9 (Table 1).

3.2. Results of pain, knee stiffness and performance difficulty

The pain intensity in the intervention group was significantly higher than that in the control group ($P=0.003$). After treatment, the pain intensity was significantly lower than that in the control group ($P=0.001$). There was no significant difference in knee stiffness in the control and intervention groups before intervention ($P=0.5$). But after the intervention, the knee stiffness was significantly lower in the intervention group than the control group ($P=0.001$). Before the intervention, performance difficulty was significantly higher in the intervention group ($P=0.002$), and after the intervention, the performance difficulty was significantly lower in the intervention group than that in the control group ($P=0.001$) (Table 2).

4. Discussion

This clinical trial was conducted to evaluate the effect of a rehabilitation program on surgical outcomes (pain, knee stiffness, and performance difficulty) in patients undergoing TKR surgery. All participants were present in the study from the beginning to the final stage. The results showed that rehabilitation intervention relieved pain in patients undergoing knee replacement surgery. Rehabilitation education made the rehabilitation nurse closer to the patients during the treatment process, so that the nurse can better

Table 1. Sociodemographic characteristics of the participants.

Variables	Intervention group (n=48)	Control group (n=48)	P-value
Age (mean±SD)	65.39±5.08	63.83±5.14	0.13
Gender [n (%)]			
Male	2 (4.2%)	7 (14.6%)	0.15
Female	46 (95.8%)	41 (85.4%)	
Education [n (%)]			
Illiterate	32 (66.7%)	22 (45.8%)	0.10
Elementary	12 (25.0%)	22 (45.8%)	
High school	4 (8.3%)	4 (8.3%)	
Marital status [n (%)]			
Married	28 (58.3)	39 (81.3)	0.10
Widow	20 (41.7)	8 (16.6)	
Divorced	0	1 (2.1)	
Body mass index (BMI) [n (%)]			
18.5-24.9	7 (14.6)	7 (14.6)	0.12
25-29.9	17 (35.4)	12 (25.0)	
30-34.9	22 (45.8)	25 (52.1)	
35-39.9	2 (4.2)	4 (8.3)	
Jobs [n (%)]			
Self-employ	1 (2.1)	4 (8.3)	0.10
Housewife	46 (95.8)	39 (81.3)	
Retired	1 (2.1)	1 (2.1)	

Table 2. Effect of educational intervention on pain, knee stiffness and performance difficulty.

Groups	Pain		Knee stiffness		Performance difficulty	
	Before	After	Before	After	Before	After
Intervention group	83.43±7.06*	40.47±10.47*	68.46±11.23	19.53±12.34*	75.49±6.13*	43.48±7.96*
Control group	76.35±14.05	57.29±7.51	66.92±14.23	41.66±10.09	70.68±8.16	55.82±4.30

*: $P<0.05$, compared with the control group; Before: before intervention; After: six weeks after intervention.

understand the patients' needs and concerns. Timely information transferring to the patient during rehabilitation sessions raised patients' awareness of the disease and treatment, and reduced patient's anxiety. Other studies has confirmed that enhancing patients' understanding of their illness plays an important role in their faster recovery[11]. The results of the present study are in line with other studies, showing that rehabilitation interventions including range of motion, Straight Leg Raise and pumping ankle exercises can positively affect postoperative pain[22]. The study conducted by Chen *et al.* showed that rehabilitation exercises can reduce the pain of the patients undergoing knee replacement surgery[10]. The results of present study showed that in the first two days after surgery, the pain levels in the intervention group were lower than that in the control group, but on the 3rd day after the operation, there was no significant difference in the mean scores of pain between the study groups. This may be due to the beginning of rehabilitation exercises in the intervention group. In the following days, with strengthening leg muscles, more obvious pain reduction was observed in the intervention group compared to the control group. The results of the Chen *et al.* study confirmed that rehabilitation exercises, especially Straight Leg Raise could increase the patient's ability to walk and stand upright, and consequently improve postoperative pain, which are consistent with the results of present study.

On the other hand, the immediate initiation of a postoperative rehab program is effective in reducing pain. The study conducted by Labraca *et al.* in 2011 indicated that rehabilitation 24 h after TKR surgery showed a greater reduction in pain than 48-72 h after surgery[23]. The results of this study are in line with the Labraca *et al.* study. This study indicated a positive effect of rehabilitation intervention on knee stiffness reduction. The contrary results were found in the study conducted by Rashed Ahmad and Khaled Said in 2008. They reported that there were not significantly difference in mean scores of post-operative knee stiffness between experimental and control groups[24]. According to studies, muscle performance before surgery is an important for determining the quadriceps muscle strength after surgery[12]. By increasing the function of quadriceps muscle, knee stiffness can be improved after surgery. In the study conducted by Rashed Ahmad and Khaled Said, all patients in the control and the intervention groups suffered from severe osteoarthritis, resulting in a complete loss of quadriceps muscle performance and muscle weakness due to less muscle use[24]. As a result, the lack of improvement in knee stiffness and rehabilitation after the surgery can be expected. Also, the inability to perform exercises due to knee stiffness before surgery can result in the patients' unwillingness to perform post-operative rehabilitation exercises and then knee stiffness cannot be relieved as a result of reduced use of quadriceps in walking and bending. It has also been proven that patients in Saudi Arabia suffered from more loss of muscle strength due to a decline in physical activity in the age of 31-40 years of life compared with western societies. This

could be attributed to the people's beliefs and culture regarding aging and inefficiencies to live a better life. This seems to be the psychological impact on the performing exercises and improving the performance of the individual and thus improving and relieving knee stiffness.

This study also showed a positive effect of rehabilitation education on the performance difficulty. In line with the other study, the performance difficulty was decreased after rehabilitation. The study by Chen *et al.* suggested that pre-operative educational intervention provides physical fitness and greater ability to perform rehabilitation exercises, and it can results in faster recovery and better physical performance in patients undergoing TKR surgery[10]. The study conducted by McDonald *et al.* showed that the performance difficulty in patients undergoing hip replacement who received pre-operative training was lower than those who received routine care[25]. In addition, the study conducted by Kremer *et al.* showed that physical performance of patients was significantly improved in both groups receiving the home-based and clinic based rehabilitation program respectively in comparison to the baseline, and none of the group had an advantage over the other[26]. Considering the nature of the replication and practice of the rehabilitation program and its continuation after discharge, either at home or by referring to the rehabilitation clinic, the performance improvement is expected in both groups. The results of this study showed that rehabilitation for building muscles is effective on walking in TKR patients. Follow-up exercises at home, either under the supervision of a physiotherapist or at a clinic, give a similar result.

5. Conclusion

In our study, the surgical outcomes including pain, knee stiffness and performance difficulty were non significantly improved in control group, which may be due to the routine training. And due to the direct relationship between pain and anxiety, reduction in patient anxiety after surgery reduces pain perception in the patient and reduction in patient pain by performing routine physiotherapy exercises after surgery leads to the patient empowerment and, by increasing person's muscle strength, knee stiffness is also decreased, which is also increasingly enhances patient physical functioning in both groups. Anyway, the intervention group with rehabilitation program under the supervision of the rehabilitation nurse had a better surgical outcomes than control group.

The rehabilitation education supervised by a nurse helps to improve the surgical outcomes of patients undergoing TKR surgery, and is effective for faster rehabilitation and early discharge. Therefore, as an integral part of the healthcare chain, more attention should be paid to patient education, and more respect should be paid to nurses, who are mainly responsible for patient education and are main members of the health care team.

Conflict of interest statement

The authors report no conflict of interest.

Authors' contribution

M.A.F.: Study design, S.A.: Data collection, S.H.: Data analysis, M.A.F, S.A, and S.H. contributed to the final version of the manuscript. M.A.F. supervised the project.

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