

## Original Article

# EFFECT OF PREOPERATIVE EXERCISE ON MEASURES OF FUNCTIONAL STATUS IN MEN AND WOMEN UNDERGOING TOTAL KNEE REPLACEMENT: A RANDOMIZED CONTROLLED TRIAL

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## ABSTRACT

Total Knee Replacement (TKR) is the standard treatment for patients with severe knee osteoarthritis (OA). Significant improvement in pain and function are seen after TKR and approximately 80% of patients are very satisfied with the outcome. Functional status prior to TKR is a major predictor of outcome after the intervention. However, results from several previous trials testing the concept have been inconclusive after surgery. There was a significant increase in functional status in subjects undergone TKR. Exercise training shows significant improvement in the functional outcome of knee

**KEY WORDS:** Total Knee Replacement, Exercise training, Educational training.

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## INTRODUCTION

Osteoarthritis (OA) is the most common joint disorder and a common cause of pain, loss of function and disability in older adults [1]. It is the second most common diagnosis made in older adults seeking medical care [2] and the leading cause of disability at older age [3]. When suffering from severe OA, Total Joint Replacement (TJR) is the preferred treatment option to significantly improve function and pain [2,4]. Given the demographic change with growing segment of the senior population in the Western World, the rate of these procedures will rise exponentially over the next decade. This will result in high health-care expenditures due to the absolute increase in TJR surgery (both direct hospital charges and indirect costs) [5].

Progression of symptoms often leads to decreased mobility, deconditioning, and reduced functional status and quality of life. Total joint arthroplasty improves pain and its sequelae in patients with end-stage arthritis [6-8].

The current EULAR (European League Against Rheumatism) recommendations include exercise as an effective treatment in the improvement of pain and function in patients with moderate to severe knee OA (effect size for validated outcome measures of pain and function versus placebo range from 0.57 to 1.0) [9]. Similarly, the OARSI (Osteoarthritis Research Society International) supports the benefits of exercise in patients with knee OA, both on pain and function [10].

Notably, exercise alone may delay but not prevent TJR in severe OA [11]. Similarly, however, TJR does not fully restore function in many patients undergoing the procedure [12-14], which in part may be due to long-term mechanical impairments of the joint. The most recent review published on pre-operative interventions for patients with hip or knee osteoarthritis awaiting joint replacement was published in 2011 and included 23 trials [15]. The authors concluded that there was low to moderate quality evidence for the benefit of pre-operative exercise for Total Knee Replacement (TKR). These data are consistent with three earlier systematic reviews [16-18]. Little attention has been placed on the potential role exercise might play in preparation for surgery. However, the effects of preoperative exercise programs on post-TKA functional restoration are still under investigation.

This study may have particular relevance to total joint arthroplasty, because preoperative functional status has been shown to be strongly related to postoperative status in knee arthroplasty patients [19]. Rook et al. 2002 reported that a 6-week preoperative exercise program improved muscle strength and functional ability, thereby reducing the LOS following TKA [20].

In this study we aim to test a well-defined and feasible training program in measures of functional status undergoing TKR. The purpose of this study was to investigate the effects of a simplified preoperative rehabilitation and education program intervention on functional status in patients who were admitted to undergo TKA.

## **MATERIALS AND METHODS**

A Single blinded randomized controlled trial was conducted by taking institutional ethical clearance. With single blinded randomization technique, the 60 subjects with scheduled TKR were recruited from body line hospital, Ahmedabad. The patients were allotted with single blinded randomization to group A and group B respectively. Group A: 30 (12-male, 18-female) subject with planned TKR receiving only education session. Group B: 30 (13-male, 17-female) subject with planned TKR receiving

training and educational session. Age group of 50-90 years, severe primary or secondary OA, Both male and female were included for the study. Cognitive impairment, Revision surgery for TKR, Any plan to leave place before or after surgery, History of inflammatory arthritis and inability to walk at least 3 meters with or without walking aid, Knee joint surgery, Ligament injury to the knee joint, Post fracture stiffness, Unwillingness to attend all the treatment sessions & assessments were excluded in the study.

The subjects were screened based on the inclusion and exclusion criteria and signified their voluntary decision to participate. Demographic data was obtained from the subjects. The purpose and procedure of the study was explained to the subjects and informed consent was obtained. Information about TKR surgery was also explained.

Subjects between 50 -90 years of both gender with primary and secondary OA were included in this study. Cognitive impairment, Revision surgery for TKR, Any plan to leave place before or after surgery, History of inflammatory arthritis and inability to walk at least 3 meters with or without walking aid, Knee joint surgery, Ligament injury to the knee joint, Post fracture stiffness were excluded in this study.

60 subjects of planned TKR are included in the study that fulfills the inclusion criteria after thorough physical objective evaluation, clinical reasoning process. All the patients were divided into group A and group B using single blinded randomization technique. The baseline data were obtained from both the groups using KSS and WOMAC index as an outcome measure.

The exercise protocol was adapted from previous studies by our group of persons with osteoarthritis and fibromyalgia. Because this was our first exercise study of patients undergoing total joint replacement, we selected a regimen of exercises and progression of intensity of the intervention to accommodate the expected level of deconditioning seen in patients with osteoarthritis. [21-23]

The exercise group performed land-based exercise 3 times weekly over a 6-week period immediately prior to surgery. During the first 3

weeks, participants performed 1–2 sets of 8–12 repetitions of single-joint movements while standing in chest-deep. During weeks 4–6, exercise sessions involved a total body fitness program of cardiovascular, strength, and flexibility training. Participants used the recumbent stationary bicycle or walking for 10 minutes of cardiovascular exercise at moderate intensity. Strength training activities, the focus of the intervention, were performed and included chest press, and leg press movements using resistance machines; biceps curl and triceps kickback exercises using hand weights; and movements for the shoulders and abdomen using bodyweight. Two sets of 8–12 repetitions of each resistance activity were performed at each session. The intervention was individually tailored to each person’s fitness level and comfort with performing the movements. At the end of each session, participants performed flexibility exercises involving hip, knee, and ankle flexors and extensors and hip adductors, holding each position for 20 seconds and repeating twice. A physical therapist administered the exercise sessions, which lasted 30–60 minutes and took place at a community fitness facility.

We used information from the preoperative education provided to all patients undergoing total joint arthroplasty as our control intervention. Education included information on modifying a home to improve accessibility and to reduce the risk of falling and injury for a person recovering from total joint replacement surgery. It also includes information on preparing for surgery and things to bring for the hospital stay. Patients in the education control group received education during week 1 of the 6-week intervention and a follow up telephone call during week 2, 4 and 6. In this single-blinded RCT, the intervention group will receive a minimum of 8 and a maximum of 24 training sessions plus 3 educational sessions of the knee school. The control group will receive the 3 educational sessions only. Assessments are performed immediately before and 6 months after surgery. KSS and WOMAC index were used as outcome measures to assess the baseline values and the progression.

**Statistical Analysis:** All the statistical analysis

was done by using SPSS 17 for windows software. Intra group comparison for KSS and WOMAC Index were done by Wilcoxon Signed Rank test for both the groups. Descriptive analysis for both groups was also done. The KSS and WOMAC were analyzed with median value before and after intervention.

The inter group comparison for KSS and WOMAC were analyzed with non parametric Mann Whitney U test for homogeneity and treatment effect between two groups and median as a central value for both.

**Table 1:** Pre treatment group comparison of KSS Index.

Group	KSS Index			z value	p value
	Minimum	Maximum	Median		
A	42	64	51	0.726	0.468
B	39	68	52		

This table shows the intergroup comparison of KSS done by using Mann Whitney U test. The median for group A and B is 51 and 52 respectively. The z value is 0.726 and p value is 0.468 which shows that there is no significant difference between the pre treatment values of KSS. It proves the pre treatment homogeneity of both the groups before the intervention.

**Table 2:** Pre treatment group comparison of WOMAC Index.

Group	WOMAC Index			z value	p value
	Minimum	Maximum	Median		
A	42	64	51	0	1
B	42	64	51		

The median for group A and B is 51. The z value is 0.000 and p value is 1.000 which shows that there is no significant difference between the pre treatment values of WOMAC Index. It proves the pre treatment homogeneity of both the groups before the intervention.

**Table 3:** Pre and post treatment comparison of group A- KSS.

	KSS			z value	p value
	Minimum	Maximum	Median		
Pre treatment	42	64	51	4.787	0
Post treatment	52	76	66		

The table shows intra group comparison of KSS for Group A. Analysis was done by using Wilcoxon signed Rank test. The median of pre test and post test is 51.00 and 66.00 respectively. The z value for KSS is 4.787 and p value 0.000. It indicates educational training is statistically significant in improving functional status in subjects done TKR.

**Table 4:** Pre and post treatment comparison of group A- WOMAC Index.

WOMAC Index				z value	p value
	Minimum	Maximum	Median		
Pre treatment	52	76	51	2.338	0.019
Post treatment	52	75	50		

The table shows intra group comparison of WOMAC Index for Group A. Analysis was done by using Wilcoxon signed Rank test. The median of pre test and post test is 51.00 and 50.00 respectively. The z value for WOMAC Index is 2.338 and p value 0.019. It indicates educational training alone is not statistically significant in improving functional status in subjects with TKR.

**Table 5:** Pre and post treatment comparison of group B- KSS.

KSS				z value	p value
	Minimum	Maximum	Median		
Pre treatment	38	68	52	4.787	0
Post treatment	60	76	68		

The table shows intra group comparison of KSS for Group A. Analysis was done by using Wilcoxon signed Rank test. The median of pre test and post test is 52.00 and 68.00 respectively. The z value for KSS is 4.787 and p value 0.000. It indicates educational training is statistically significant in improving functional status in subjects done TKR.

**Table 6:** Pre and post treatment comparison of group B- WOMAC Index.

WOMAC Index				z value	p value
	Minimum	Maximum	Median		
Pre treatment	42	64	51	4.787	0
Post treatment	52	76	66		

The table shows intra group comparison of WOMAC Index for Group A. Analysis was done by using Wilcoxon signed Rank test. The median of pre test and post test is 51.00 and 50.00 respectively. The z value for WOMAC Index is 2.338 and p value 0.019. It indicates educational training alone is not statistically significant in improving functional status in subjects with TKR.

**Table 7:** Post treatment group comparison- KSS.

KSS				z value	p value
Groups	Minimum	Maximum	Median		
A	52	76	66	6.439	0
B	60	76	68		

This table shows the inter group comparison of post treatment values for KSS. The median of Group A is 66 and Group B is 68. The z value of KSS is 6.439 and p value is 0.000. It is showing that there is significant difference in preoperative training programme in improving functional status in treatment TKR.

**Table 8:** Post treatment group comparison- WOMAC Index.

WOMAC Index				z value	p value
Groups	Minimum	Maximum	Median		
A	42	55	50	6.558	0
B	52	76	66		

This table shows the inter group comparison of post treatment values for WOMAC Index. The median of Group A is 50 and Group B is 66. The z value of WOMAC Index is 6.558 and p value is 0.000. It is showing that there is significant difference in pre operative exercise programme in improving functional status in treatment of TKR.

## DISCUSSION

This randomized controlled trial will compare the effect of pre-operative exercise training plus education training on measures of functional status in subjects undergoing TKR. The feasible training program aims to improve the activity-oriented outcome measures.

A single blinded randomized controlled study has been done on 60 subjects of planned TKR. All the patients were divided into group A (educational training group) and group B (exercise group). The subjects of group A received only educational training and group B received exercises training with education. Assessments are performed immediately before and 6 months after surgery. The baseline data were obtained from both the groups using KSS and WOMAC index as an outcome measure.

Our findings suggest that men and women with severe osteoarthritis can safely increase lower-extremity muscle strength through participation in a program of cardiovascular fitness, strength training, and flexibility exercise prior to TKR. The improvement in strength after exercise is accompanied by improved levels of function in men and women scheduled for TKR. Participation in preoperative exercise is strongly associated with a reduced use of inpatient rehabilitation

Our findings conflict with those of one prior study reporting that participants in a preoperative physical therapy group went to rehabilitation facilities more often than controls. The potential economic implication of this finding is noteworthy and should be examined in future studies, particularly with the rise in inpatient rehabilitation use [24].

Our trial will also contribute to evidence-based guidelines to help physicians and patients make informed decisions. With respect to patient functional status, the major predictor of patient functional status postoperatively is pre-operative status. It is therefore important to test the benefit of pre-operative training in patients undergoing TKR and our trial could contribute to a definition of pre-operative treatment recommendations or guidelines.

## CONCLUSION

The study led to the conclusion that pre-operative exercise training is effective in improving functional status in subjects undergoing total knee replacement in agreement with the literature.

**Conflicts of interest:** None

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