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Effect of Pre-habilitation on Functional Recovery after Total Knee Arthroplasty: A Randomized Controlled Trial

Riaz Muhammad[1], Sardar Sohail Afsar[2], Yaqoob Ur Rehman[3], Afaq Uddin[*4]

[1]Specialist Registrar Orthopedic Nowshera Medical College

[2]Professor of Orthopaedic Nowshera Medical College and Qazi Hussain Ahmad Medical Complex Nowshera

[3]Assistant Professor Orthopedic Nowshera Medical College

[*4]Assistant Professor Orthopedic Nowshera Medical College

***Corresponding Author:**

Afaq Uddin

Email ID: afaq.6191@gmail.com

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ABSTRACT

Background: The most common degenerative disease is osteoarthritis of the knee, which has become more common in recent years. It is a major source of work-related impairment in Western nations, where its incidence among adults surpasses 20%. Pain management and improving joint function are the main goals of the treatment approach for knee osteoarthritis.

Objective: To determine the effect of Pre-habilitation on Functional Recovery after Total Knee Arthroplasty

Methodology: The current randomized controlled trial study was carried out at the orthopaedic department, Nowshera Medical College and Qazi Hussain Ahmad Medical Complex Nowshera. The study duration was one year from March 2023 to March 2024 after taking approval from the ethical committee of the hospital. In the current study, a total of 120 patients were enrolled. They were divided into control group and preoperative rehabilitation group. Sixty patients were placed in each group. The intervention group received a structured preoperative rehabilitation program that included supervised exercise sessions designed to increase cardiovascular fitness, joint flexibility, and lower limb strength. The program took place three times a week for the four weeks before to surgery. The control group received standard preoperative treatment, and no structured exercise regimen was put in place. Six weeks and three months after surgery, mobility was evaluated using the Timed Up and Go (TUG) test. To measure post-surgery pain, VAS was used. The quality of life was evaluated concurrently using the Knee Injury and Osteoarthritis Outcome Score (KOOS). Data was collected at the beginning, six weeks, and three months after surgery. SPSS version 24 was used for data analysis.

Results: In the current study, a total of 120 patients were enrolled. They were divided into control group and preoperative rehabilitation group. Sixty patients were placed in each group. In the baseline characteristics no statistical significant difference was observed between the two groups ($p>0.05$). At the 3- month follow-up, the rehabilitation group continued to exhibit improvement in functional mobility, with a time difference of 12.6 (2.01) seconds compared to 15.3 (1.99) seconds in the control group ($p=0.005$). At six weeks and three months after surgery, the rehabilitation group had less pain, as indicated by the VAS score. In the rehabilitation group, the mean (SD) duration of hospital stay was 3.7 (0.4) days, whereas in the control group it was 4.3 (0.99) days ($p = 0.001$).

Conclusion: Our research concluded that preoperative rehabilitation significantly increases functional mobility, reduces pain, and enhances quality of life in patients undergoing total knee arthroplasty.

Keywords: *Effect; Pre-habilitation; Functional Recovery; Total Knee Arthroplasty*

1. INTRODUCTION

The most common degenerative illness is osteoarthritis of the knee, which has become more common in recent years. It is a major source of work-related impairment in Western nations, where its incidence among adults surpasses 20% (1). Pain management and improving joint function are the main goals of the treatment approach for osteoarthritis in the knee (2). Medication, weight control, and functional exercise are examples of initial therapy approaches. Knee arthroplasty, on the

other hand, provides significant relief and is the only effective therapy for end-stage osteoarthritis (3). However, knee arthroplasty is quite invasive and requires patients to meet strict health requirements. As a result, in 1940, researchers recommended using the preoperative period for early rehabilitation activities to improve recovery and postoperative results (4). Pre-rehabilitation or prehabilitation is the term used to describe this kind of preoperative rehabilitation (5). It consists of preventative medicine, health education, and functional exercise. On the other hand, normal nursing procedures like education for a brief period before surgery are often the sole part of conventional preoperative treatments. Prehabilitation's effects on postoperative recovery have shown mixed outcomes in clinical trials. Some clinical experiences challenge the findings of many researches that show prehabilitation has no appreciable positive effects on surgical outcomes (6–8). Although there are theoretical benefits to preoperative rehabilitation, there is mixed evidence about its efficacy in treating patients who have had total knee arthroplasty (TKA) (7-9). Some research have shown encouraging outcomes, like improved postoperative function and reduced hospital stays, whereas other studies have not revealed any notable differences from standard care. These conflicting findings highlight the need for further research to completely understand the impact of prehabilitation on postoperative outcomes in patients having total knee replacements (10, 11). Examining the impact of a structured preoperative rehabilitation program on the functional outcomes of total knee replacements was the aim of this randomized controlled study. By comparing the postoperative recovery of patients who receive prehabilitation with those who receive conventional treatment, this study sought to provide compelling evidence regarding whether prehabilitation might enhance functional outcomes, reduce recovery times, and raise overall patient satisfaction following total knee arthroplasty. The study explores which specific prehabilitation program components have the most effects on improved outcomes, providing patients and healthcare providers with vital information.

2. MATERIALS AND METHODS

The current randomized controlled trial study was carried out at the orthopaedic department, Nowshera Medical College and Qazi Hussain Ahmad Medical Complex Nowshera. The study duration was one year from March 2023 to March 2024 after taking approval from the ethical committee of the hospital. In the current study, a total of 120 patients were enrolled. They were divided into control group and preoperative rehabilitation group. Sixty patients were placed in each group.

The study's inclusion criteria were adults aged 50 to 75 who were scheduled for primary total knee arthroplasty (TKA) and had been diagnosed with end-stage osteoarthritis. Participants have to be able to provide informed consent and be willing to participate in the preoperative rehabilitation program. The exclusion criteria included a history of neurological diseases that affected mobility, a history of previous knee surgery, patients getting physical therapy for other conditions, or patients with significant cardiovascular or pulmonary issues that prevented them from being active. Furthermore, if the researcher thought the patient's condition would make it impossible for them to complete the trial, they were disqualified.

The intervention group received a structured preoperative rehabilitation program that included supervised exercise sessions designed to increase cardiovascular fitness, joint flexibility, and lower limb strength. The program took place three times a week for the four weeks before to surgery. The control group received standard preoperative treatment, and no structured exercise regimen was put in place. Six weeks and three months after surgery, mobility was evaluated using the Timed Up and Go (TUG) test. To measure post-surgery pain, VAS was used. The quality of life was evaluated concurrently using the Knee Injury and Osteoarthritis Outcome Score (KOOS). Data was collected at the beginning, six weeks, and three months after surgery. SPSS version 24 was used for data analysis. Rates and percentages were employed to display binary data, whereas means and standard deviations were used to display continuous parameters. The findings of the two groups were compared using independent t-tests and chi-square. If the p-value was less than 0.05, it was considered statistically significant. Prior to their participation in the study, each subject provided written informed consent. As part of the permission process, a detailed explanation of the research's objectives, procedures, potential risks, and benefits was given. Participants in the trial were assurances that their involvement was completely voluntary and that their ability to get standard medical care would not be impacted if they choose to withdraw from the study. To maintain data confidentiality, each participant was assigned a unique identification number, and all data was safely stored with only the research staff having access.

3. RESULTS

In the current study, a total of 120 patients were enrolled. They were divided into control group and preoperative rehabilitation group. Sixty patients were placed in each group. In the baseline characteristics no statistical significant difference was observed between the two groups ($p>0.05$). The mean age (SD) in the control group was 63.9 (4.99) years while in rehabilitation group it was 64.22 (5.01) years ($p=0.6$). The male patients in control group were 25 (41.67%) and female patients were 35 (58.3%). The male patients in rehabilitation group were 24 (40%) and female patients were 36 (60%) ($p=0.3$). (Figure 1) The mean BMI (SD) was 30.29 (3.99) kg/m² in control group while in rehabilitation group it was 29.99 (4.86) kg/m² ($p=0.2$). The mean (SD) baseline TUG test time was 18.1 (2.00) seconds in control group while in rehabilitation group it was 19.1 (1.42) seconds ($p=0.9$). The mean (SD) VAS score was 7.1 (1.11) in control group while in rehabilitation group it was 7.3 (1.42) ($p=0.07$). The mean (SD) Knee injury and Osteoarthritis Outcome Score (KOOS) in control group was 38.99 (2.44) while in rehabilitation group it was 38 (3.00) ($p=0.07$). (Table 1) In comparison to the control group, the mean TUG test time in rehabilitation group showed a substantial improvement at six weeks postoperatively. The mean (SD)

TUG test time in control group was 16.7 (1.22) seconds, while in the rehabilitation group it was 14.3 (1.25) (p=0.008). At the 3- month follow-up, the rehabilitation group continued to exhibit improvement in functional mobility, with a time difference of 12.6 (2.01) seconds compared to 15.3 (1.99) seconds in the control group (p=0.005). (Table 2)

At six weeks and three months after surgery, the rehabilitation group had less pain, as indicated by the VAS score. At six weeks, the mean VAS score (SD) in rehabilitation group was 3.7 (1.11), while in control group it was 4.5 (1.42) (p = 0.009). At three months, the mean VAS score (SD) in rehabilitation group was 2.6 (0.99), while in control group it was 3.9 (1.42) (p = 0.007). (Table 2) At the 3-month follow-up, the mean (SD) KOOS score was 52 (6.44) in controlled group while in rehabilitation group it was 58 (4.66) points (p=0.003). The mean increase in KOOS score points was 13.01 (4.00) while in rehabilitation group it was 20 (1.66) (p = 0.009). (Table 3)

In the rehabilitation group, the mean (SD) duration of hospital stay was 3.7 (0.4) days, whereas in the control group it was 4.3 (0.99) days (p = 0.001). (Table 3)

Table 1: Baseline characteristics of both the groups

Parameter	Controlled group	Rehabilitation group	P value
Mean age (years)	63.9 (4.99)	64.22 (5.01)	0.6
Mean BMI (kg/m²)	30.29 (3.99)	29.99 (4.86)	0.2
Mean baseline TUG Test (seconds)	18.1 (2.00)	19.1 (1.42)	0.09
Mean baseline VAS Pain Score	7.1 (1.11)	7.3 (1.42)	0.07
Mean KOOS score	38.99 (2.44)	38 (3.00)	0.07

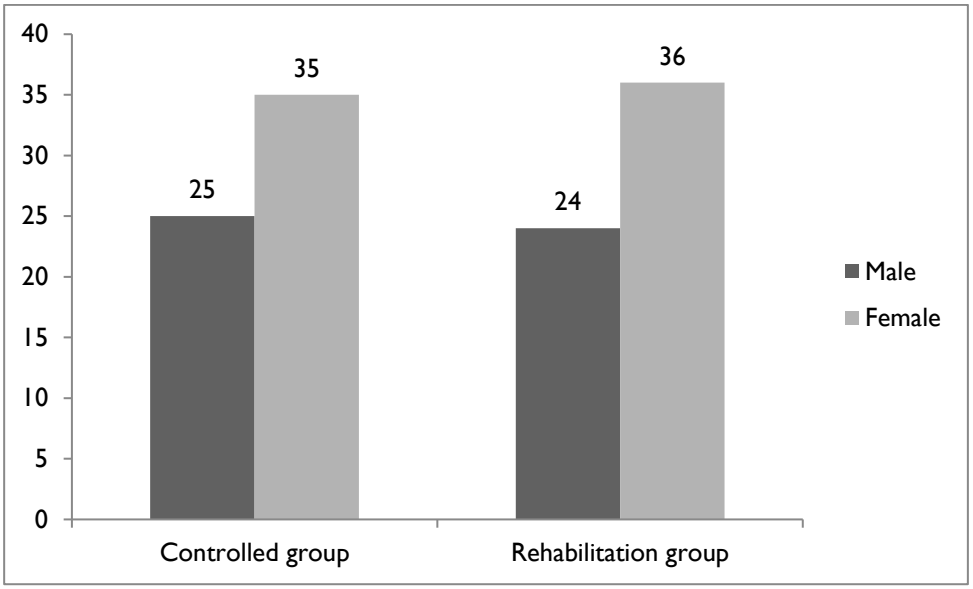

Figure 1: Gender wise distribution of patients in both the group

Table 2: Mean TUG time and VAS score of patients enrolled in both the groups

Parameter	Sub category	Controlled group	Rehabilitation group	P value
TUG Test (seconds)	baseline	18.1 (2.00)	19.1 (1.42)	0.09
	At six weeks	16.7 (1.22)	14.3 (1.25)	0.008
	At third month	12.6 (2.01)	15.3 (1.99)	0.005

Mean baseline VAS Pain Score	baseline	7.1 (1.11)	7.3 (1.42)	0.07
	At six weeks	3.7 (1.11)	4.5 (1.42)	0.009
	At third month	2.6 (0.99)	3.9 (1.42)	0.007

Table 3: Mean KOOS score and hospital stay comparison in both the group

Parameter	Controlled group	Rehabilitation group	P value
Mean baseline KOOS score	38.99 (2.44)	38 (3.00)	0.07
At third month KOOS score	52 (6.44)	58 (4.66)	0.003
Mean increase in KOOS score from Baseline score	13.01 (4.00)	20 (1.66)	0.009
Mean Hospital stay	4.3 (0.99)	3.7 (0.4)	0.001

4. DISCUSSION

According to the findings of this randomized controlled trial, after a structured preoperative rehabilitation program, patients undergoing total knee arthroplasty (TKA) had significantly improved functional mobility, reduced discomfort, and an improved quality of life. These results are consistent with prior research that examined the role of prehabilitation after orthopedic surgeries, particularly total knee replacement. According to the results of the Timed Up and Go (TUG) test, the rehabilitation group's functional mobility significantly increased, which is in line with earlier studies that have shown the benefits of preoperative exercise programs (12). Prehabilitation may enhance functional outcomes after surgery, particularly in terms of reducing the recovery time for recovered mobility, per a meta-analysis. Previous research has shown that patients who participated in prehabilitation had better early postoperative outcomes, including greater muscle strength and gait speed (13, 14), which likely contributed to our study's quicker recovery. However, it's important to keep in mind that several studies failed to find a statistically significant difference in postoperative function between the prehabilitation and control groups (6). Changes in the duration and intensity of the prehabilitation programs as well as in the timing of the outcome assessments may account for this discrepancy. The four-week prehabilitation regimen we used in our experiment may have provided sufficient stimulus to produce the observed increases in functional mobility. The reduction in postoperative pain levels in the rehabilitation group is another significant finding of our study. This result is supported by research showing that patients who exercised before to surgery had less pain and needed fewer analgesics (15). Stronger muscles around the knee joint, improved joint flexibility, and a higher pain threshold may be the mechanism behind this advantage, which aids in improved pain management after surgery. However, several research have not shown that prehabilitation substantially reduces pain levels (16). Different patient demographics, varying exercise routines and intensities, or disparate pain assessment methods might all be contributing factors to the disparities in the outcomes. Our study's results suggest that a well planned and strictly followed prehabilitation program may really enhance pain management and maybe the patient's overall recovery process. The KOOS's assessment of the rehabilitation group's improved quality of life demonstrates the all-encompassing benefits of prehabilitation. Previous studies have shown that preoperative exercise enhances not only physical performance but also patients' perceptions of their health and well-being (17). Given that patients often have a lengthy recovery period after total knee arthroplasty (TKI), which may have a detrimental impact on their mental and emotional health, this improvement in life quality is particularly significant. Other studies, particularly in the early postoperative period, indicated little effect on many aspects of quality of life, even though all KOOS subscales shown significant improvements in our study. The long follow-up period of our trial may have contributed to this disparity by allowing the benefits of prehabilitation to gradually become apparent. The shorter hospital stay for the rehabilitation group is in line with studies that suggest prehabilitation may speed up surgical recovery and allow for an earlier discharge (18, 19). By cutting costs and making better use of the resources at hand, shortened hospital stays may have a big effect on healthcare systems. However, other studies have not shown a statistically significant difference in hospital stays between the control and prehabilitation groups (20). The degree of inconsistency in the results may depend on the specific discharge criteria that are used as well as the efficiency of the postoperative care protocols. The feasibility and safety of implementing prehabilitation programs in clinical practice are supported by the program's high adherence rate and the absence of notable side effects. This outcome is consistent with the study, which demonstrates that adherence rates are often high when patients believe the program is beneficial and is well incorporated into their preoperative treatment regimen (21).

5. CONCLUSION

Our research concluded that preoperative rehabilitation significantly increases functional mobility, reduces pain, and enhances quality of life in patients undergoing total knee arthroplasty. The technique also has the advantage of

good adherence, few adverse reactions, and a shorter hospital stay. These findings support the idea that, in order to improve recovery and postoperative outcomes, prehabilitation should be a routine component of TKA patients' care.

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