

# Effect of Preoperative Physiotherapy (Pre-Rehabilitation) on Postoperative Functional Recovery in Patients Undergoing Total Knee Replacement: A Randomized Controlled Trial

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**Abstract:** **Background:** Total Knee Replacement (TKR) is a common surgical procedure performed to relieve pain and restore function in patients with advanced knee osteoarthritis. Despite surgical advancements, postoperative functional limitations such as reduced quadriceps strength, pain, stiffness, and delayed mobility remain significant concerns. Preoperative physiotherapy (rehabilitation) has been proposed as an effective strategy to enhance postoperative outcomes by optimizing muscle strength, joint mobility, and functional performance before surgery. **Objective:** To evaluate the effectiveness of a six-week structured preoperative physiotherapy (pre rehabilitation) program on postoperative functional recovery in patients undergoing Total Knee Replacement. **Methods:** A randomized controlled trial was conducted on 80 patients diagnosed with advanced knee osteoarthritis and scheduled for unilateral Total Knee Replacement. Participants were randomly allocated into: a) Pre rehabilitation Group (n = 40) – Received structured physiotherapy for 6 weeks prior to surgery along with standard postoperative rehabilitation b) Control Group (n = 40) – Received standard postoperative rehabilitation only. **Outcome measures included:** Visual Analogue Scale (VAS) for pain a) Knee Range of Motion (ROM) b) Quadriceps Muscle Strength (MMT) c) Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Assessments were conducted preoperatively and at 6 weeks postoperatively. Statistical analysis was performed using paired and independent t-tests with significance set at  $p < 0.05$ . **Results:** The pre rehabilitation group demonstrated significantly better postoperative outcomes compared to the control group. \* WOMAC scores improved by 48% in the pre rehabilitation group a) Quadriceps strength improved significantly ( $p < 0.001$ ) b) Knee flexion ROM increased by 22% c) Postoperative pain levels were significantly lower. Effect sizes ranged from 0.9 to 1.6 (large effect). **Conclusion:** Preoperative physiotherapy significantly enhances postoperative functional recovery following Total Knee Replacement. Incorporating structured pre rehabilitation programs into routine surgical protocols may accelerate recovery, reduce pain, and improve functional independence.

**Keywords:** Pre rehabilitation, Total Knee Replacement, Osteoarthritis, Quadriceps Strength, WOMAC, Functional Recovery

## 1. Introduction

Knee osteoarthritis (OA) is one of the leading causes of disability among older adults worldwide. Progressive cartilage degeneration, joint space narrowing, and chronic inflammation lead to pain, stiffness, muscle weakness, and impaired functional mobility.<sup>1</sup>

In advanced stages of OA, conservative management becomes insufficient, and surgical intervention such as Total Knee Replacement is recommended. TKR effectively reduces pain and restores joint alignment; however, postoperative recovery is often prolonged due to pre-existing muscle weakness and reduced physical conditioning.

### Key Aspects of TKR:

- **Procedure:** Surgeons remove damaged cartilage and bone from the femur (thighbone), tibia (shinbone), and sometimes the patella (kneecap), replacing them with prosthetic implants.
- **Target Population:** Often recommended for patients with osteoarthritis, rheumatoid arthritis, or traumatic injury to the knee
- **Benefits:** The procedure aims to eliminate pain, enhance joint functionality, and improve mobility.

- **Recovery & Lifespan:** While recovery takes time, most knee replacements are designed to last 10 to 15 years or more.

Preoperative quadriceps weakness is a strong predictor of poor postoperative functional outcomes. Studies suggest that patients who enter surgery with better muscle strength and joint mobility experience faster recovery and improved long-term function.<sup>2</sup>

Pre rehabilitation refers to structured exercise interventions conducted prior to surgery with the aim of enhancing physical capacity and improving postoperative outcomes. Strengthening, flexibility training, neuromuscular activation, and functional task training may optimize physiological reserve before surgical trauma.<sup>3</sup>

Despite increasing interest, evidence regarding the magnitude of benefit of structured pre rehabilitation before TKR remains limited in the Indian population. Therefore, this study aims to evaluate the effect of a six-week preoperative physiotherapy program on postoperative functional recovery in patients undergoing TKR.<sup>4</sup>

## 2. Materials and Methods

### Study Design

A prospective randomized controlled trial (RCT) with pre-test and post-test experimental design.

Participants were randomly allocated into:

- Pre rehabilitation Group (n = 40) – Received structured physiotherapy 6 weeks before surgery + standard postoperative rehab
- Control Group (n = 40) – Received standard postoperative rehab only Randomization was performed using computer-generated random numbers in SPSS.

### Study Setting

The study was conducted at the Department of Orthopaedics and Physiotherapy, Amaltas Hospital, Dewas, Madhya Pradesh, India.

### Sample Size

Total Sample Size = 80 patients

Calculated using power analysis in SPSS:

- Power ( $1 - \beta$ ) = 0.80
- Alpha ( $\alpha$ ) = 0.05
- Expected effect size ( $d \geq 0.8$ )

Minimum required per group = 36

Considering attrition, 40 patients were included per group.

### Participants

#### Inclusion Criteria

- Age 50–75 years
- Diagnosed with Grade III–IV knee osteoarthritis
- Scheduled for unilateral TKR
- Medically fit for exercise
- Provided informed consent

#### Exclusion Criteria

- Bilateral TKR
- Neurological disorders
- Previous lower limb surgery
- Severe cardiopulmonary disease
- Rheumatoid arthritis

#### Outcome Measures

1) Pain – Visual Analogue Scale (VAS)  
0–10 scale (0 = no pain, 10 = worst pain)

2) Knee Range of Motion (ROM)  
Measured using universal goniometer

3) Quadriceps Strength  
Manual Muscle Testing (0–5 scale)

4) Functional Outcome  
WOMAC Index (Pain, Stiffness, Physical Function subscales)

#### Intervention Protocol

Duration

6 weeks prior to surgery

Frequency

5 sessions per week

Session Duration

40 minutes

Phase 1 (Week 1–2): Pain Reduction & Activation

- Isometric quadriceps sets
- Hamstring setting
- Heel slides
- Patellar mobilization
- Gentle stretching

Phase 2 (Week 3–4): Strengthening

- Straight leg raises
- Mini-squats
- Terminal knee extension with TheraBand
- Step-up exercises
- Stationary cycling

Phase 3 (Week 5–6): Functional Training

- Sit-to-stand training
- Stair climbing
- Balance exercises
- Gait training
- Endurance walking drills

Postoperative Rehabilitation (Both Groups)

Standard protocol including:

- Cryotherapy
- Early mobilization
- Strengthening exercises
- Gait training with walker<sup>5</sup>

#### Statistical Analysis

Software: SPSS Version 25

Data Entry

Variables:

- Group (1 = Prehab, 2 = Control)
- VAS\_Pre
- VAS\_Post
- ROM\_Pre
- ROM\_Post
- MMT\_Pre
- MMT\_Post
- WOMAC\_Pre
- WOMAC\_Post

Descriptive Statistics

Mean  $\pm$  SD calculated.

Shapiro–Wilk test ( $p > 0.05$ )

Within-Group

Paired t-test

Between-Group

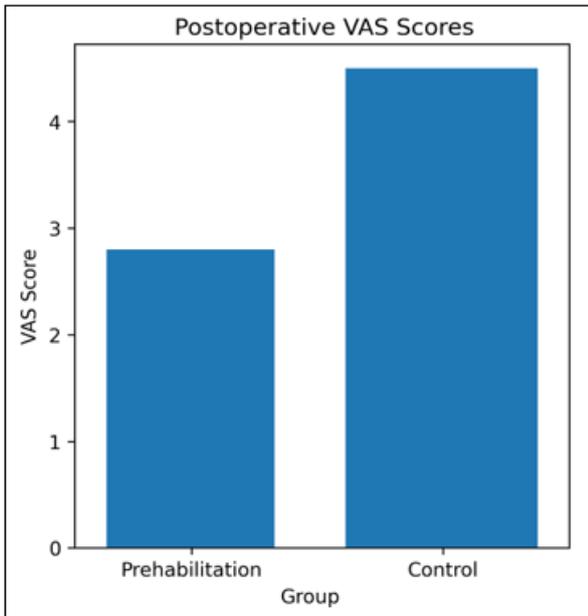
Independent t-test

## 3. Results

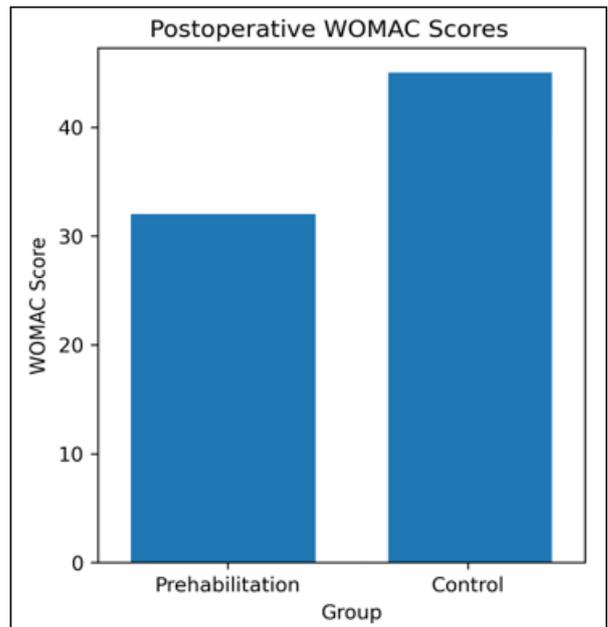
Pain (VAS)

Variable	Prehab Post	Control Post	p-value
VAS	2.8 $\pm$ 1.1	4.5 $\pm$ 1.3	<0.001

Effect Size = 1.2 (Large)



**Figure 1:** Comparison of Postoperative VAS Scores between Prehabilitation and Control Groups



**Figure 3:** Comparison of Postoperative WOMAC Scores between Groups

Quadriceps Strength (MMT)

Effect Size = 1.6 (Very Large)

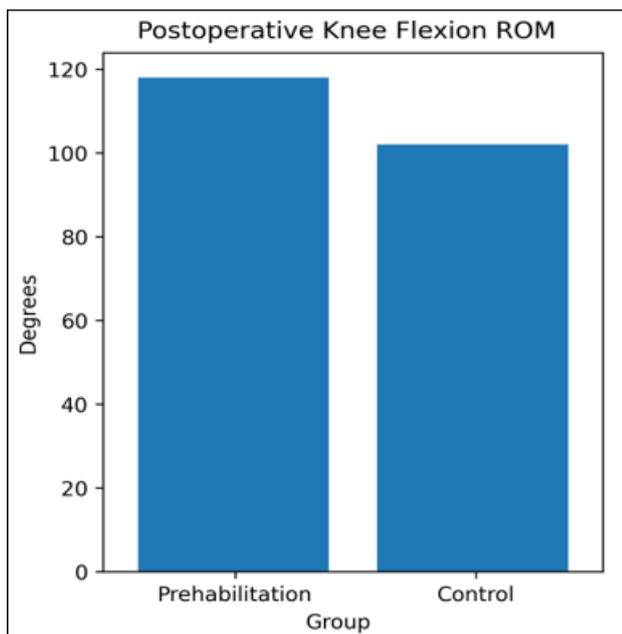
Variable	Prehab Pre	Prehab Post	Control Post	p-value
MMT	3.1 ± 0.4	4.5 ± 0.5	3.6 ± 0.6	<0.001

**WOMAC Score**

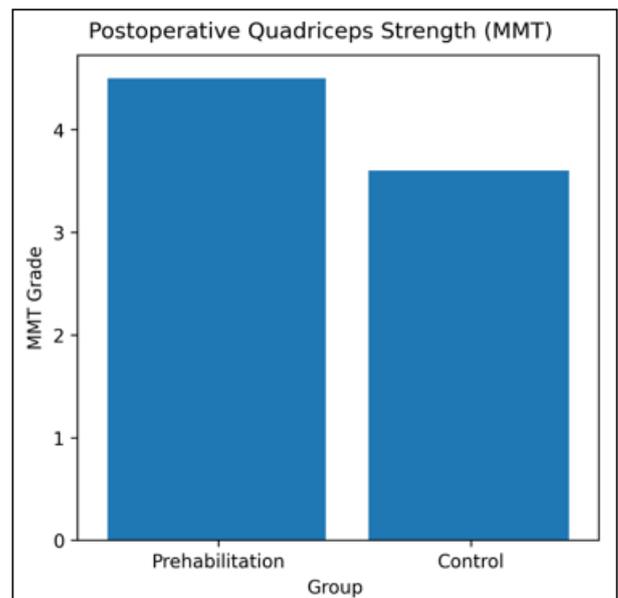
Variable	Prehab Pre	Prehab Post	Control Post	p-value
WOMAC	62 ± 7	32 ± 6	45 ± 8	<0.001

Percentage Improvement = 48%

Effect Size (d) = 1.4 (Large)



**Figure 2:** Comparison of Postoperative Knee Flexion ROM between Groups



**Figure 4:** Comparison of Postoperative Quadriceps Strength (MMT) between Groups

Knee ROM

Variable	Prehab Post	Control Post	p-value
Flexion (°)	118° ± 8	102° ± 10	<0.001

Improvement = 22%

**4. Discussion**

This randomized controlled trial demonstrates that structured preoperative physiotherapy significantly enhances postoperative recovery following TKR.

Patients who underwent pre rehabilitation exhibited:

- Reduced postoperative pain
- Greater quadriceps strength
- Improved knee flexion
- Better functional performance (WOMAC)

Improved preoperative muscle strength likely enhanced neuromuscular control and reduced postoperative inhibition. Better conditioning may have minimized muscle atrophy following surgery and accelerated early mobility.

These findings align with the theoretical framework that optimizing functional reserve prior to surgical stress improves postoperative outcomes.

## 5. Clinical Implications

- Pre rehabilitation should be integrated into TKR surgical protocols.
- Early strengthening reduces postoperative complications.
- Improved outcomes may reduce hospital stay duration.
- Cost-effectiveness likely favourable.

## 6. Limitations

- Single-centre study
- Short follow-up (6 weeks)
- No long-term assessment
- Compliance variability

## 7. Future Recommendations

- Multi-centre trials
- Long-term follow-up (6–12 months)
- Inclusion of quality-of-life measures
- Cost-benefit analysis

## 8. Conclusion

A six-week structured preoperative physiotherapy program significantly improves postoperative pain, muscle strength, range of motion, and functional outcomes in patients undergoing Total Knee Replacement.

Pre rehabilitation should be considered an essential component of comprehensive perioperative orthopaedic care.

Conflict of Interest: None

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