

# Effects of a Hybrid Cardio–Orthopaedic Prehabilitation Physiotherapy Program on Functional Outcomes in Patients Undergoing Total Knee Replacement: A Randomized Controlled Trial

<sup>1</sup>Dr.Aishwarya Aghamkar, <sup>2</sup>Dr.Arпита Rathod

<sup>1,2</sup>Associate Professor

Tilak Maharashtra Vidyapeeth Indutai Tilak College of Physiotherapy Pune

## Abstract

**Background:** Prehabilitation has emerged as an effective strategy to enhance postoperative outcomes in patients undergoing Total Knee Replacement (TKR). Limited evidence exists regarding integrated cardiovascular and orthopedic physiotherapy.

**Aim:** To evaluate the effectiveness of a hybrid cardio–orthopaedic prehabilitation program on functional capacity, pain, and postoperative recovery.

**Methods:** A randomized controlled trial was conducted with 60 TKR candidates. Group A received standard prehabilitation; Group B underwent a hybrid program combining aerobic training, strengthening, neuromuscular training, and endurance conditioning. Outcome measures included 6MWT, VAS, WOMAC, quadriceps strength, and postoperative ambulation time.

**Results:** Group B showed significantly greater improvements in functional capacity (+22% in 6MWT), reduced pain, better WOMAC scores, earlier ambulation, and superior strength gains ( $p < 0.05$ ).

**Conclusion:** Hybrid cardio–orthopaedic prehabilitation significantly enhances functional outcomes and surgical recovery compared to standard prehabilitation.

## Introduction

Total Knee Replacement (TKR) is one of the most commonly performed and successful orthopedic procedures worldwide. Despite advances in surgical technique and implant design, postoperative outcomes remain influenced by the patient's preoperative physical status. Prehabilitation, defined as preoperative physiotherapy aimed at optimizing physical and functional capacity, has shown promising results in improving postoperative mobility, reducing pain, and enhancing overall recovery.

Traditional prehabilitation focuses predominantly on joint-specific strengthening and mobility. However, growing literature suggests that cardiovascular conditioning can improve aerobic capacity, promote better circulation, reduce inflammation, and increase resilience to surgical stress. A hybrid cardio–orthopaedic model integrates aerobic endurance training with targeted musculoskeletal rehabilitation, offering a comprehensive approach to preparing patients for TKR. However, evidence from the Indian population remains limited.

This study evaluates the effectiveness of such a hybrid prehabilitation model compared to standard physiotherapy in improving pre- and postoperative outcomes in TKR patients.

## Methodology

**Study Design:** Randomized Controlled Trial. **Sample Size:** 60 participants (30 per group).

**Inclusion Criteria:** Age 50–75 years, diagnosed knee osteoarthritis scheduled for TKR, medically stable for exercise.

**Exclusion Criteria:** Cardiac instability, neurological involvement, prior knee surgery.

**Interventions:**

**Group A – Standard Prehabilitation:**

- Quadriceps strengthening
- Hamstring stretching
- ROM exercises
- Gait training

**Group B – Hybrid Cardio–Ortho Prehabilitation (45–60 min/session, 3 sessions/week for 4 weeks):**

1. Cardiovascular Training:
  - Treadmill or cycling at 65–75% HRmax
2. Orthopaedic Component:
  - Quadriceps, gluteal, and hip strengthening

- Neuromuscular and closed-chain training
- Balance training, step-ups
- 3. Endurance & Breathing:
  - Diaphragmatic breathing
- Incentive spirometry Outcome Measures:
  - 6-Minute Walk Test (6MWT)
  - Visual Analog Scale (VAS)
  - WOMAC Index
  - Quadriceps strength (handheld dynamometer)
- Time to first independent ambulation postoperatively Statistical Analysis:  $p < 0.05$  considered statistically significant.

## Results

Group B demonstrated significantly greater improvements:

- 6MWT distance increased by 22% (vs. 9% in Group A).
- VAS pain scores reduced more effectively.
- WOMAC functional scores improved significantly.
- Earlier postoperative ambulation was achieved.
- Quadriceps strength gains were higher.

Overall, the hybrid prehabilitation program produced superior results across all evaluated parameters.

## Discussion

The findings indicate that integrating cardiovascular conditioning with orthopedic rehabilitation enhances preoperative fitness and postoperative outcomes. Aerobic training likely improved muscle oxygenation, systemic circulation, and endurance. Neuromuscular training promoted better joint stability and motor control. Additionally, respiratory training may have contributed to reduced postoperative fatigue and improved mobility.

The hybrid model is feasible, low-cost, and easily applicable in physiotherapy settings, offering a practical approach for optimizing surgical readiness in TKR patients.

## Conclusion

Hybrid cardio-orthopaedic prehabilitation significantly improves functional capacity, pain levels, quadriceps strength, and postoperative recovery in TKR patients. The results support adopting integrated physiotherapy models to maximize surgical outcomes and enhance quality of life.

## References

1. Gill SD, McBurney H. *Physical Therapy Reviews*. 2013;18(3):169–180.
2. Wang L et al. *Journal of Arthroplasty*. 2021;36(5):1763–1773.
3. Moyer R et al. *Orthopedic Nursing*. 2017;36(4):276–282.
4. Topp R et al. *Arthritis Care & Research*. 2009;61(2):174–180.
5. Hoogbeem TJ et al. *Current Opinion in Anaesthesiology*. 2010;23(2):161–166.
6. Swank AM et al. *J Strength Cond Res*. 2011;25(2):318–325.
7. Bossmann T et al. *Eur Rev Aging Phys Act*. 2018;15:1–9.
8. Minns Lowe CJ et al. *BMJ*. 2007;335:812.
9. Di Monaco M et al. *Aging Clin Exp Res*. 2009;21(5):349–353.
10. Papalia R et al. *British Medical Bulletin*. 2014;112(1):115–125.