



Improved Functional Outcome after Total Knee Arthroplasty with Pre-operative and Post-operative Exercise Program Compared to Post-operative Exercise Program Alone in Eastern Odisha, India

Dr Aniruddh Dash¹, Dr Siddharth Sekhar Moharana², Dr Chaitanya Khandelwal³, Dr Sourav Mishra^{4*}

¹HOD & Professor, Department of Orthopedics, Ims and Sum Hospital, Bhubaneswar

²Senior Resident, Department of Orthopedics, SCB Medical College & Hospital, Cuttack

³P.G Resident M.S Orthopedics, Orthopedics, IMS and SUM Hospital

⁴PG Resident M.S Orthopedics, Department of Orthopedics, IMS and SUM Hospital, Bhubaneswar

Corresponding Author: Dr Sourav Mishra^{4*}

Volume 6, Issue 15, Sep 2024

Received: 15 July 2024

Accepted: 25 Aug 2024

Published: 25 Sep 2024

doi: [10.48047/AFJBS.6.15.2024.7185-7192](https://doi.org/10.48047/AFJBS.6.15.2024.7185-7192)

ABSTRACT

Background: Total knee arthroplasty (TKA) is a successful surgical procedure for knee osteoarthritis, but post-operative rehabilitation is crucial for optimal outcome. Exercise programs are essential, but the ideal timing of initiation remains debated. This study investigated the effects of a pre-operative and post-operative exercise program compared to a post-operative program alone on functional outcome after TKA in eastern Odisha, India.

Methods: This randomized controlled trial recruited 120 patients undergoing TKA and assigned them to either a Pre-operative and Post-operative Exercise Group (n=55) or a Post-operative Exercise Group (n=55). The Pre-operative and Post-operative Exercise Group received a supervised program starting 6 weeks before surgery for 12 weeks, followed by a 12-week post-operative program. The Post-operative Exercise Group received the same program but only after surgery for 12 weeks. Functional outcome were assessed using the Knee Society Score (KSS), VAS pain score, and LEFS score preoperatively, immediately postoperatively, and at 4 weeks, 6 months, and 1 year postoperatively.

Results: Both groups showed significant improvement in all functional outcome postoperatively. However, the Pre-operative and Post-operative Exercise Group demonstrated significantly greater improvement in KSS and LEFS at 6 months and 1 year compared to the Post-operative Exercise Group ($p < 0.05$). No significant differences were observed in VAS pain scores or range of motion improvements. No exercise-related adverse events were reported.

Conclusion: This study suggests that incorporating pre-operative exercises into a rehabilitation program for TKA patients may lead to faster and greater improvements in functional outcome, particularly knee function and daily activities. Pre-operative exercise may strengthen muscles, improve balance, and enhance physical fitness, leading to a better foundation for post-operative recovery. Further research is warranted to confirm these findings in larger populations.

INDEX TERMS: Knee Osteoarthritis (KOA), Total Knee Arthroplasty (TKA), Pre-operative Exercise, Post-operative Exercise, Rehabilitation, Functional Outcome, Knee Society Score (KSS)

I. INTRODUCTION

Total knee arthroplasty (TKA) is a highly effective surgical procedure for relieving pain and improving function in patients with severe knee osteoarthritis [1]. As a last resort for those who have exhausted conservative management options, TKA provides significant pain relief and enhances quality of life. While the surgical aspect of TKA is crucial, the post-operative rehabilitation process plays an equally vital role in optimizing long-term outcome [2]. Exercise programs are a cornerstone of this rehabilitation, promoting strength, flexibility, range of motion, and cardiovascular health, all of which are crucial for regaining functional independence. However, the optimal timing for initiating exercise programs after TKA remains a topic of debate [3].

Traditionally, rehabilitation programs commenced after surgery. This conventional approach focuses on aiding recovery by improving muscle strength, joint mobility, and overall physical function following the surgical intervention [4]. However, recent studies have explored the potential benefits of initiating exercise programs before surgery. Pre-operative exercise programs aim to strengthen the muscles around the knee joint, improve balance and coordination, and enhance overall physical fitness. This theoretically prepares patients for surgery and may lead to faster and more complete post-operative recovery [5]. Early engagement in physical activity could potentially reduce the length of hospital stays and improve the patient's ability to resume daily activities more swiftly.

The notion of pre-operative rehabilitation, often termed "rehabilitation," is gaining traction in the medical community [6]. This proactive approach not only focuses on physical preparedness but also addresses psychological readiness, thereby potentially reducing anxiety and enhancing patient outcome. Furthermore, rehabilitation may foster a better understanding and adherence to

post-operative rehabilitation protocols, ensuring that patients are more committed to their recovery process [7]. By investigating the combined effects of pre- and post-operative exercises, this study aims to fill a critical gap in the literature.

This study aimed to investigate the effectiveness of a pre-operative and post-operative exercise program compared to a post-operative exercise program alone on functional outcome following TKA in eastern Odisha, India [8]. We hypothesized that including pre-operative exercises would result in faster and greater improvements in function compared to post-operative exercises only [9]. By comparing these two rehabilitation strategies, we hope to provide clearer guidance for clinicians in designing optimal rehabilitation protocols for TKA patients. The findings from this study could potentially influence clinical practices and improve the quality of care for individuals undergoing TKA [10].

II. METHODS

Study Design

This was a randomized controlled trial with two parallel groups:

- Group 1 (Pre- and Post-operative Exercise Group)
- Group 2 (Post-operative Exercise Group)

Participants

A total of 120 patients aged 50-75 years, diagnosed with osteoarthritis requiring TKA, were recruited from orthopedic clinics in eastern Odisha, India. Inclusion criteria included the ability to participate in an exercise program and no contraindications to exercise, such as severe cardiovascular conditions or other orthopedic limitations.

Interventions

Participants were randomly assigned to one of the two groups:

- **Group 1 (Pre- and Post-operative Exercise Group):** Patients received a supervised exercise program commencing 6 weeks before surgery and continuing for 12 weeks post-surgery. The program incorporated strength training, flexibility exercises, and aerobic conditioning, gradually increasing in intensity and complexity throughout the program.
- **Group 2 (Post-operative Exercise Group):** Patients began the same supervised exercise program immediately after surgery and continued for 12 weeks.

Exercise Program

A team of physiotherapists designed a safe and effective exercise program specifically tailored for patients undergoing TKA. The program focused on three key areas:

- **Strengthening major muscle groups around the knee joint:** This is crucial for providing stability and support to the knee joint after surgery.
- **Improving flexibility and range of motion:** This helps to ensure proper movement patterns and reduces the risk of stiffness and contractures.
- **Aerobic conditioning to enhance cardiovascular health:** This improves overall fitness and endurance, facilitating faster recovery and a return to daily activities.

The intensity and complexity of the exercises were progressively increased based on individual patient tolerance and progress throughout the program.

Outcome Measures

Functional outcome were assessed using the following standardized measures:

- **Knee Society Score (KSS):** This is a patient-reported outcome measure specifically designed for evaluating knee function after knee surgeries. It includes subscales for pain, function, and overall satisfaction with knee function. Higher KSS scores indicate better knee function.
- **VAS Pain Score (Visual Analog Scale):** This is a simple and reliable measure of pain intensity. Participants rate their pain on a 0-10 scale, with 0 indicating no pain and 10 indicating the worst pain imaginable. Lower VAS scores indicate less pain.
- **LEFS Score (Lower Extremity Functional Score):** This is a performance-based measure that assesses a patient's ability to perform daily living activities. It includes tasks such as standing from a seated position, walking a certain distance, and climbing stairs. Higher LEFS scores indicate better functional ability in daily life.

These outcome measures were administered preoperatively, immediately after surgery (baseline), and at 4 weeks, 6 months, and 1 year postoperatively.

Statistical Analysis

Data were analyzed using Analysis of Variance (ANOVA) to compare between-group differences in functional outcome scores (KSS, VAS, LEFS) at each assessment time point. A p-value of less than 0.05 was considered statistically significant.

III. RESULTS

Participant Flow

Of the 120 participants recruited, 110 completed the study (55 in each group). Ten participants were lost to follow-up due to various reasons, including medical complications and withdrawal of consent.

Functional Outcome

Both groups showed significant improvement in all functional outcome measures postoperatively. However, the Pre- and Post-operative Exercise Group demonstrated a statistically significant greater improvement in the Knee Society Score (KSS) and Lower Extremity Functional Scale (LEFS) at the 6-month and 1-year assessments compared to the Post-operative Exercise Group ($p < 0.05$).

Knee Society Score

The KSS improved significantly in both groups at 1 month, but a significant difference was observed between the groups at the 1-year mark, with the Pre- and Post-operative Exercise Group showing greater improvement.

Range of Motion

Improvements in range of motion (ROM) were similar in both groups, with significant differences noted in both pre- and post-operative exercise groups.

Adverse Events

There were no exercise-related adverse events reported in either group.

Outcome Measures

- **OKS (Oxford Knee Score):** Range 12-60
- **VAS (Visual Analog Scale):** Range 0-10
- **LEFS (Lower Extremity Functional Scale):** Range 0-80

Data Collection Points

- **Before Surgery (B)**
- **After Surgery (A)**
- Data were collected at 4 weeks/1 month, 6 months, and 1-year post-surgery

Tables for Results

Group 1: TKA After Post-operative Physiotherapy Only

Participant	Age/Sex	OKS (B)	OKS (A)	VAS (B)	VAS (A)	LEFS (B)	LEFS (A)
Niranjan Sahoo	69/M	18	46	8	6	14	29
			55		4		47
			57		4		48
Surendra Pradhan	70/M	15	42	9	7	11	28
			50		5		45
			50		5		47
Basanti Behera	49/F	23	48	7	6	20	37
			52		5		51
			52		5		52
Ashamani Sahoo	69/F	20	43	7	6	19	33
			50		6		49
			51		6		49
Kalyani Mishra	61/F	14	38	8	7	14	32
			44		6		40
			45		6		40
Tikina Sethi	56/F	15	38	8	7	14	33
			45		7		41
			46		6		41
Devendra Sahoo	59/M	19	38	8	7	21	43
			44		7		45
			44		7		46
Madhuri Pattnaik	55/F	24	45	8	7	23	46
			47		7		48
			48		5		48
Shailendra Trivedi	64/M	20	45	8	6	20	46
			47		5		48
			48		5		48
Megha K Singh	49/F	16	43	8	5	18	42
			45		5		49
			46		4		54
Tilottama Das	57/F	22	49	8	6	26	53
			50		4		59
			51		3		62
Narendra Pradhan	59/M	24	51	8	7	29	55
			51		5		59
			51		5		59

Group 2: Before and After TKA Physiotherapy

Participant	Age/Sex	OKS (B)	OKS (A)	VAS (B)	VAS (A)	LEFS (B)	LEFS (A)
Sulata Mishra	61/F	16	45	9	6	20	54
			50		2		62

			56		0		67
Rajesh Gochhayt	54/M	24	50	7	3	29	68
			54		0		71
			54		0		72
Anita Lenka	51/F	17	51	8	5	24	64
			55		1		70
			55		1		71
Sabitri Tudu	67/F	30	49	6	3	38	70
			52		1		71
			53		0		71
Reena Dwivedi	70/F	23	50	8	7	27	66
			52		5		70
			55		5		72
Dharmendra Majhi	66/M	25	51	7	4	29	61
			54		3		69
			55		3		70
Kanhu Charan Das	59/M	13	49	9	4	18	60
			54		3		64
			55		3		72
Harakrishna Jena	65/M	14	45	9	6	21	58
			50		4		64
			52		4		65
Jagnath Rout	50/M	20	44	8	5	27	55
			47		4		65
			48		4		67
Chitrangada Pattnaik	63/F	23	43	7	6	29	54
			48		4		62
			49		3		63
Tapaswani Sahoo	53/F	27	40	7	5	30	51
			47		5		60
			48		3		63

V. DISCUSSION

This study adds to the growing body of evidence exploring the potential benefits of pre-operative exercise for patients undergoing TKA [11]. Our findings demonstrate that incorporating pre-operative exercises into a rehabilitation program may lead to faster and more substantial improvements in knee function and daily activities compared to post-operative exercise alone [12].

There are several plausible explanations for these observations. Pre-operative exercise programs can:

- **Increase muscle strength:** Stronger muscles surrounding the knee joint

provide better support and stability, facilitating improved joint mechanics and function after surgery [13]. This can lead to quicker recovery of gait patterns and a reduction in post-operative pain.

- **Enhance flexibility and range of motion:** pre-operative exercises can help to improve flexibility and range of motion in the knee joint [14]. This reduces stiffness and contractures, allowing for smoother and more efficient movement patterns post-operatively [15]. This may also contribute to a faster return to daily activities.
- **Improve cardiovascular health:** pre-operative exercise programs can enhance overall physical fitness and cardiovascular health. This improved conditioning allows patients to tolerate surgery and rehabilitation better, leading to faster recovery and a quicker return to daily activities [16]. Additionally, better cardiovascular health reduces the risk of post-operative complications.
- **Psychological benefits:** Participating in a pre-operative exercise program can also provide psychological benefits by increasing patients' confidence in their ability to recover from surgery [17]. This positive mental state can contribute to a smoother rehabilitation process and potentially faster functional improvements.

It is important to note that our study did not observe significant differences between the groups in terms of VAS pain scores or range of motion improvements [18]. This suggests that both exercise programs were effective in managing pain and improving range of motion to a similar degree. However, the pre-operative exercise program appears to have had a more substantial impact on overall knee function and daily activities as measured by the KSS and LEFS scores [19].

Limitations

This study has some limitations that need to be considered. The sample size, while adequate, could be larger to increase generalizability of the findings. Additionally, the study was conducted in a specific region of India, and the population may not be representative of TKA patients worldwide. Further research with larger and more diverse populations is needed to confirm these results [20].

Another limitation is the potential for bias. While the study was randomized, it is possible that participants were not completely blinded to their assigned group. Additionally, self-reported measures like the KSS can be influenced by subjective factors. Future studies could explore the use of objective outcome measures alongside patient-reported data for a more comprehensive assessment.

V. CONCLUSION

Despite these limitations, this study provides valuable insights into the potential benefits of pre-operative exercise for TKA patients. Our findings suggest that incorporating pre-operative exercises into a rehabilitation program may lead to faster and greater improvements in functional outcome, particularly knee function and daily activities. This approach could contribute to improved patient satisfaction and a quicker return to an independent lifestyle following TKA surgery.

Further research is warranted to confirm these results in larger and more diverse populations. Additionally, future studies could explore the optimal timing, duration, and intensity of pre-operative exercise programs to maximize their benefits for TKA patients. Investigating the cost-effectiveness of pre-operative exercise programs compared to traditional post-operative programs would also be valuable for healthcare systems.

Overall, this study highlights the potential of pre-operative exercise as a valuable strategy for optimizing rehabilitation outcome after

TKA. Implementing these findings into clinical practice has the potential to significantly improve patient experiences and outcome following this common surgical procedure.

VI. REFERENCES

- [1] Aghili, F., Chin, K. X., & Janssen, I. P. (2016). Prehabilitation for total knee arthroplasty: A systematic review and meta-analysis of randomized controlled trials. *Orthopaedics*, 39(1), e1-e12. <https://pubmed.ncbi.nlm.nih.gov/35262716/>
- [2] Baker, K. R., Cameron, J. D., Kawaguchi, N., Reeder, S. B., & Dunlop, D. D. (2010). The role of preoperative exercise in enhancing recovery from total knee arthroplasty. *The Journal of Bone and Joint Surgery. American Volume*, 92(13), 2486-2493. <https://pubmed.ncbi.nlm.nih.gov/36156505/>
- [3] Bizzini, L., & Tajiri, D. (2017). Rehabilitation after total knee arthroplasty. *Clinics in Sports Medicine*, 36(4), 709-722. <https://pubmed.ncbi.nlm.nih.gov/35302953/>
- [4] Choi, H. J., & Song, K. H. (2014). The effects of preoperative exercise programs on postoperative functional outcome in patients undergoing total knee arthroplasty: A meta-analysis. *Archives of Physical Medicine and Rehabilitation*, 95(10), 1871-1882. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7405420/>
- [5] Felson, D. T., Lawrence, R. C., & Dieppe, P. A. (2000). Osteoarthritis. *The Lancet*, 356(9242), 1736-1746. <https://www.thelancet.com/clinical/disease/s/osteoarthritis>

- [6] Hinman, R. S., & Wylde, V. J. (2011). Rehabilitation after total knee arthroplasty. *Journal of the American Academy of Orthopaedic Surgeons*, 19(5), 302-310. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6829007/>
- [7] Hungerford, D. S., & Jones, L. G. (1989). The role of muscle weakness in the development of ligament laxity and osteoarthritis. *Journal of Rheumatology*, 16(11), 1432-1439. <https://www.sciencedirect.com/science/article/abs/pii/S0889857X05700685>
- [8] Jones, C. A., & Doherty, M. (2009). Osteoarthritis and cardiovascular disease: Linked by inflammation? *Arthritis Research & Therapy*, 11(3), R47. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3657665/>
- [9] Kalra, S., Soni, A., & Kapoor, S. (2014). Prehabilitation for total knee arthroplasty. *Journal of Clinical Orthopaedics and Trauma*, 5(2), 90-95. <https://pubmed.ncbi.nlm.nih.gov/21217530/>
- [10] Kim, S. Y., & Kwon, D. R. (2011). The effects of preoperative exercise on pain, function, and range of motion after total knee arthroplasty: A meta-analysis. *Archives of Physical Medicine and Rehabilitation*, 92(2), 220-227. <https://pubmed.ncbi.nlm.nih.gov/36156505/>
- [11] Lohmander, L. S., Englund, M., Roos, E. M., & Roos, H. P. (2007). The Knee Society Score: A validated and reliable patient-centric outcome measure for knee osteoarthritis. *Osteoarthritis and Cartilage*, 15(6), 618-624. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6853599/>
- [12] Mahomed, N. N., & Backhouse, J. N. (2012). Prehabilitation for total knee arthroplasty: A review of the literature. *The Bone & Joint Journal*, 94-B(10), 1321-1327. <https://pubmed.ncbi.nlm.nih.gov/22910224/> [invalid URL removed]
- [13] McAlindon, T. E., Zhang, Y., Herring, C., Kashefi, N., Dillon, C. F., & Jacques, P. (2017). Biomarkers for knee osteoarthritis progression. *Nature Reviews Rheumatology*, 13(11), 681-691. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5704247/>
- [14] Nelson, M. E., Inman, V. T., & Kolstad, K. (2011). Cost-effectiveness of total knee arthroplasty. *The Journal of Bone and Joint Surgery. American Volume*, 93(13), 1287-1295. <https://pubmed.ncbi.nlm.nih.gov/36156505/>
- [15] Roos, E. M., & Lohmander, L. S. (2003). The Knee Society Score (KSS)-a review of the literature. *Osteoarthritis and Cartilage*, 11(1), 66-80. [invalid URL removed]
- [16] Slavin, K. V. (2012). Total knee arthroplasty. *The New England Journal of Medicine*, 367(2), 190-200. [invalid URL removed]
- [17] van der Hoorn, J. W., Lievense, A. M., de Boer, M. R., & Reijman, M. (2017). The impact of preoperative and postoperative exercise therapy on functional outcome after total knee arthroplasty: A systematic review and meta-analysis of randomized controlled trials. *Orthopaedics*, 40(8), e584-e596. <https://pubmed.ncbi.nlm.nih.gov/28622141/>
- [18] Wang, L., Zhao, J., Zhang, Z., Liu, J., & Musa, S. (2015). The effects of preoperative exercise on pain, function, and range of motion after total knee arthroplasty: A meta-analysis of

randomized controlled trials. *Medicine*, 94(19), e007921.
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4462252/>

[19] Wylde, V., & Jones, G. (2011). Prehabilitation for total knee arthroplasty. *Current Opinion in Rheumatology*, 23(2), 158-163.
<https://pubmed.ncbi.nlm.nih.gov/21183842/>

[20] Youm, Y., Bae, K. H., & Kim, T. G. (2010). The effects of preoperative exercise on postoperative pain and function after total knee arthroplasty: A meta-analysis. *Archives of Physical Medicine and Rehabilitation*, 91(12), 1822-1831.