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Original Research Article

Comparison of Early Versus Delayed Physiotherapy in Patients Undergoing Total Knee Replacement: An Observational Study

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Abstract:

Background: Total knee arthroplasty (TKA) is a standard treatment for advanced osteoarthritis, yet the timing of postoperative rehabilitation remains debated. Early physiotherapy, started within 24 hours, is proposed to enhance mobility, reduce pain, and shorten hospital stay, whereas delayed physiotherapy, initiated after 48 hours, focuses on wound healing and pain control. Prior studies also support early mobilization for improved outcomes. This study compared early versus delayed physiotherapy following TKA in a tertiary care center in Gujarat, India.

Materials and Methods: A prospective randomized controlled trial was conducted for one year at a tertiary hospital in Gujarat. Patients aged 50–75 years with unilateral TKA for primary osteoarthritis were randomized (1:1) into early physiotherapy (EP; <24 hours post-surgery) or delayed physiotherapy (DP; >48 hours). Interventions included standardized quadriceps strengthening, knee flexion/extension, and gait training, performed three times daily for 30–45 minutes. Patients with uncontrolled comorbidities or prior knee surgery were excluded. Outcomes were assessed at baseline, day 3, week 2, and month 3 using the Visual Analog Scale (VAS), goniometer-measured range of motion (ROM), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and length of stay (LOS). Ethical approval and informed consent were obtained.

Results: A total of 100 patients (mean age 62.4 ± 7.2 years; 62% female) completed the study. Groups were comparable at baseline. EP patients reported lower VAS pain scores on day 3 (3.2 vs. 5.1; $p<0.001$), greater ROM at week 2 (85° vs. 72°; $p<0.01$), and improved WOMAC scores at month 3 (28.5 vs. 35.7; $p=0.002$). LOS was shorter in EP (4.8 vs. 6.3 days; $p<0.001$). Complication rates were similar.

Conclusion: Early physiotherapy after TKA improves pain, ROM, function, and reduces LOS without added risk. Adoption in tertiary centers could enannce recovery and resource efficiency.

Keywords: TKA, Early Physiotherapy, Delayed Rehabilitation, Pain, Range Of Motion, Function.

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Introduction

Total knee arthroplasty (TKA) is a cornerstone procedure for relieving pain and restoring mobility in advanced knee osteoarthritis, particularly in aging populations of developing nations such as India. With prosthetic and surgical advancements, success rates exceed 90%, yet postoperative rehabilitation remains pivotal for long-term outcomes. Traditionally, physiotherapy was delayed to allow wound healing and pain control, but recent evidence suggests early mobilization may reduce complications like deep vein thrombosis and muscle atrophy. [1]

The debate between early (<24 hours) and delayed (>48 hours) physiotherapy revolves around balancing faster recovery with potential risks of wound dehiscence or increased pain. Early protocols introduce gentle range-of-motion exercises and assisted ambulation to preserve neuromuscular function, while delayed regimens emphasize passive modalities before active engagement. International studies, such as Liebs et al. (2012), report superior functional gains with early initiation, and Indian cohorts, including Gupta et al. (2019), show comparable benefits despite higher comorbidity burdens. These findings highlight the importance of tailoring rehabilitation to local contexts, where cultural factors like family support influence adherence. [2]

In India, osteoarthritis prevalence is rising due to lifestyle changes and genetic predispositions, creating economic and healthcare pressures. [3] Optimizing rehabilitation is critical to reduce

disability, shorten hospital stays, and lower readmissions. However, gaps remain in prospective regional data, particularly from tertiary centers in Gujarat, where patient populations span rural and urban backgrounds with variable access to physiotherapy. This study was therefore designed to generate robust local evidence and contribute to global discussions on individualized rehabilitation strategies.

Materials and Methods

This prospective observational study was carried out over a one-year period at the Department of Orthopedics, at a tertiary care center in Gujarat, India, serving a diverse population of over 500 TKA cases annually. Patients were recruited consecutively from the outpatient clinic and surgical roster, with randomization performed using computer-generated blocks of 1:1 allocation to either the early physiotherapy (EP) group or the delayed physiotherapy (DP) group. The EP protocol initiated mobilization within 24 hours post-surgery, while DP began after 48 hours, ensuring a clear temporal distinction.

All surgeries were performed by two senior orthopedic surgeons using a standardized medial parapatellar approach with cemented posterior-stabilized prostheses under spinal anesthesia. Physiotherapy sessions, supervised by certified therapists, lasted 30-45 minutes thrice daily and included progressive exercises such as ankle pumps, straight-leg raises, heel slides, and assisted walking with crutches. Multimodal analgesia (paracetamol, NSAIDs, and opioids as needed) was uniform across groups to isolate rehabilitation effects. Ethical clearance was secured from the Institutional Ethics Committee. Written informed consent was obtained from all participants, emphasizing voluntary participation and confidentiality, with provisions for withdrawal without prejudice. Adverse events were monitored via daily nursing logs. Data integrity was maintained through double-entry in a secure electronic database, with interim audits to ensure compliance.

Inclusion criteria encompassed adults aged 50-75 years diagnosed with Kellgren-Lawrence grade III-IV primary osteoarthritis undergoing elective unilateral TKA, with preoperative ROM >60° and no cognitive impairments affecting compliance. Exclusion was applied to those with bilateral procedures, revision surgeries, inflammatory arthropathies like rheumatoid arthritis, uncontrolled comorbidities (e.g., HbA1c >8% for diabetes or ejection fraction <40% for cardiac issues), neurological disorders impacting mobility, or inability to commit to follow-up. Of 132 screened patients, 120 were randomized (60 per arm), with 100 completing the study (10 dropouts: 4 in EP due to infections, 6 in DP for non-compliance). Demographic details, including age, gender, BMI, and comorbidities, were recorded preoperatively to ensure group balance. Surgical variables like tourniquet time and blood loss were logged intraoperatively. Follow-up assessments occurred at baseline (pre-op), postoperative day 3, week 2 (clinic visit), and month 3 (telephonic/teleconsult if needed). Outcome measures included Visual Analog Scale (VAS) for pain (0-10), goniometric knee flexion/extension ROM, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) for function (0-96, lower better), and LOS from surgery to discharge. Complications such as infections, falls, or prosthesis issues were graded per Clavien-Dindo classification. Patient satisfaction was gauged via a 5-point Likert scale at month 3.

Statistical analysis was performed using SPSS version 25.1 with a two-tailed significance level of $p<0.05$ and 80% power to detect a 10° difference in ROM (based on prior studies like Bade et al., 2017). Continuous variables were expressed as mean ± standard deviation and compared via independent t-tests for inter-group differences or repeated-measures ANOVA for time effects.

Categorical data, including demographics and complications, were analyzed with chi-square tests. Intention-to-treat analysis incorporated last-observation-carried-forward for dropouts. Subgroup analyses explored age and BMI interactions using multivariate regression. Normality was verified via Shapiro-Wilk tests, with non-parametric alternatives (Mann-Whitney U) applied where needed. Sample size calculation assumed 15% attrition, yielding 50 completers per arm for adequate precision. Interim analysis at six months confirmed no futility or harm signals.

Results

A total of 100 patients completed the study, with balanced baseline characteristics across groups (Table 1). The mean age was 62.4 ± 7.2 years, and 62% were female, reflecting typical TKA demographics in Gujarat. No significant inter-group differences were noted in preoperative VAS pain (6.8 ± 1.3 vs. 6.9 ± 1.2; p=0.78), ROM (92° ± 15° vs. 90° ± 14°; p=0.62), or WOMAC scores (68.2 ± 10.1 vs. 69.5 ± 9.8; p=0.55). Surgical parameters, including operative time (85 ± 12 min vs. 87 ± 11 min; p=0.41) and blood loss (150 ± 45 ml vs. 155 ± 42 ml; p=0.69), were comparable.

Table 1: Baseline Demographic and Clinical Characteristics

Parameter	Early Physiotherapy (n=50)	Delayed Physiotherapy (n=50)	p-value
Age (years), mean ± SD	61.8 ± 7.0	63.0 ± 7.4	0.42
Female, n (%)	32 (64%)	31 (62%)	0.85
BMI (kg/m²), mean ± SD	27.5 ± 4.2	28.1 ± 4.5	0.51
Comorbidities, n (%)	28 (56%)	30 (60%)	0.7
Preoperative VAS	6.8 ± 1.3	6.9 ± 1.2	0.78
Preoperative ROM (°)	92 ± 15	90 ± 14	0.62

Table 2: Pain Scores (VAS) Over Time

Time Point	Early Physiotherapy (mean ± SD)	Delayed Physiotherapy (mean ± SD)	p-value
Baseline	6.8 ± 1.3	6.9 ± 1.2	0.78
Day 3	3.2 ± 1.1	5.1 ± 1.4	<0.001
Week 2	2.1 ± 0.9	2.8 ± 1.0	0.01
Month 3	1.2 ± 0.7	1.4 ± 0.8	0.32

Pain assessment via VAS revealed rapid improvement in the EP group (Table 2). Repeated-measures ANOVA confirmed a significant time-group interaction ($F=12.45$, $p<0.001$), indicating accelerated analgesia with early mobilization. Opioid requirements were also lower in EP during the first 72 hours (45 ± 18 mg morphine equivalents vs. 62 ± 22 mg; $p=0.002$).

Table 3: Range of Motion (Flexion in Degrees) Over Time

Time Point	Early Physiotherapy (mean ± SD)	Delayed Physiotherapy (mean ± SD)	p-value
Baseline	92 ± 15	90 ± 14	0.62
Day 3	65 ± 10	58 ± 9	0.005
Week 2	85 ± 12	72 ± 10	<0.01
Month 3	110 ± 8	105 ± 9	0.09

Range of motion progressed favorably in the EP cohort (Table 3).

Functional recovery, per WOMAC, showed EP superiority at all intervals except baseline (Table 4), with month 3 scores of 28.5 ± 8.2 versus 35.7 ± 9.1 ($p=0.002$). LOS averaged 4.8 ± 1.2 days for EP and 6.3 ± 1.5 days for DP ($p<0.001$), translating to potential cost savings. Complications were infrequent and balanced: superficial infections (1 vs. 2), falls (0 vs. 1), and no deep infections or revisions.

Patient satisfaction was higher in EP (4.6 ± 0.5 vs. 4.1 ± 0.6; $p=0.003$).

Table 4: Functional Scores (WOMAC) Over Time

Time Point	Early Physiotherapy (mean ± SD)	Delayed Physiotherapy (mean ± SD)	p-value
Baseline	68.2 ± 10.1	69.5 ± 9.8	0.55
Week 2	45.3 ± 7.5	52.1 ± 8.2	0.003
Month 3	28.5 ± 8.2	35.7 ± 9.1	0.002

Discussion

The postoperative phase after TKA demands both surgical precision and timely rehabilitation, with physiotherapy timing crucial to recovery. Our study highlights the clear benefits of early mobilization, which enhances function, reduces pain, and prevents deconditioning without increasing complications. In Gujarat's high-volume tertiary setting, these findings support streamlined, resource-efficient protocols aligned with ERAS principles. Reduced hospital stays ease both patient burden and system pressures, reaffirming early physiotherapy as a safe and effective strategy for optimizing outcomes. Regarding pain management, our EP group exhibited a marked VAS reduction at day 3, a pattern consistent with international evidence from Bade et al. (2017) [4], whose RCT of 120 patients post-TKA reported 40% faster analgesia with progressive rehab starting day 1, attributing gains to endorphin release and reduced edema via active circulation. Similarly, in an Indian context, Sharma et al. (2018) in a Mumbai cohort of 80 found early mobilization halved early opioid needs compared to delayed starts, mirroring our 27% decrement and highlighting applicability amid prevalent chronic pain profiles in South Asia. These comparisons validate our results, though our Gujarat sample's slightly older mean age (62 years) suggests robustness across demographics. The transient nature of the pain differential by month 3 implies early protocols accelerate, rather than solely sustain, relief, warranting integration into multimodal regimens.

For range of motion, the superior week 2 flexion in EP (85° vs. 72°) parallels Saleh et al.'s (2011) [5] Chilean trial, where 24-hour initiation yielded 12° greater gains at two weeks in 50 participants, linked to preempted capsular fibrosis. An Indian parallel emerges from Gupta et al. (2022) [6] in a Delhi study of 60, reporting 10° advantages with early protocols, akin to ours, despite higher BMI influences potentially delaying extension recovery. Our data extend these by quantifying month 3 convergence, suggesting early boosts catalyze long-term plateaus. This temporal nuance underscores the value of phased rehab, where initial intensity tapers to maintenance, a strategy our therapists adapted culturally with family-assisted home exercises. [7]

Functional outcomes via WOMAC further favored EP, with month 3 scores 20% lower, resonating with Minns Lowe et al.'s (2014) [8] systematic review of six RCTs aggregating 300 patients, which meta-analyzed a standardized mean difference of 0.45 for early versus varied protocols in daily activities. Domestically, a Vadodara investigation by Patel et al. (2020) [9] of 40 Gujarati patients echoed this with 15-point WOMAC drops, aligning closely with our 7.2-point edge and emphasizing stair-climbing improvements vital for temple-visiting lifestyles. [10] Discrepancies in subscale pain versus stiffness may reflect our cryotherapy adjunct, enhancing specificity over broader international cohorts. [11]

Length of stay emerged as a pragmatic endpoint, with EP's 1.5-day shave corroborated by Jenny et al. (2024) ultra-early trial in France, where <24-hour PT curtailed LOS by 1.2 days in 150 cases through gait milestones. In India, Singh et al. (2021) [12] from Chandigarh documented analogous 1.4-day reductions in 90 patients, validating our findings amid insurance-driven discharge pressures. Economic modeling from our data projects annual savings of INR 5 lakhs per 100 TKAs, factoring therapist time. Yet, generalizability hinges on facility readiness, as our center's dedicated bays facilitated compliance unlike understaffed peripherals.

Complication profiles showed no escalation with EP, consistent with Silva et al.'s (2023) U.S. RCT of 200, reporting equivalent 3% infection rates despite intensive rehab, due to vigilant monitoring. An Indian lens from Rao et al. (2018) [13] in Hyderabad affirmed this in 70 participants, with zero added falls, mirroring ours and countering fears of instability in osteoporotic elders. Our balanced 3% event rate likely stems from preoperative optimization, though undocumented micro-events like transient swelling warrant future kinematic tracking. Patient satisfaction, though secondary, tilted toward EP, aligning with Piva et al.'s (2019) [14] later-stage trial in the U.S., where early exercisers scored 0.5 points higher on Likert scales in 240 enrollees, tied to empowerment perceptions. Locally, a Jaipur study by Kumar et al. (2022) of 55 noted similar uplifts, resonating with our cultural emphasis on familial involvement boosting adherence. This psychosocial dimension enriches clinical metrics, suggesting holistic protocols could further amplify gains.

Limitations of this study include its single-center design, potentially limiting external validity beyond Gujarat's urban-rural mix, and a modest sample precluding rare event analyses. Follow-up to three months captures acute recovery but misses durability; longer tracking is advised. Self-reported WOMAC may introduce bias, though blinded assessments mitigated this.

Conclusion

This study demonstrates that initiating physiotherapy within 24 hours after TKA significantly improves pain relief, range of motion, function, and reduces hospital stay without added risks. Findings in 100 patients align with global and Indian evidence, showing a 20% WOMAC gain and 24% shorter LOS, supporting integration of early rehabilitation into ERAS pathways to enhance efficiency and free hospital capacity. Comparable complication rates confirm safety, while higher patient satisfaction reflects qualitative improvements in care. Nationwide adoption with cultural adaptations and future multicenter cost-effectiveness studies could further strengthen the impact of early physiotherapy in optimizing TKA recovery.

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