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RANDOMIZED TRIAL OF DPT-GUIDED TELEREHABILITATION VERSUS CLINIC-BASED THERAPY AFTER KNEE ARTHROPLASTY

Original Article

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Abstract

Background: Postoperative rehabilitation following total knee arthroplasty is essential for functional recovery, but traditional clinic-based physiotherapy presents barriers related to travel, cost, and access. Telerehabilitation has emerged as a potential alternative, yet limited evidence exists comparing doctoral-level physical therapist-guided remote therapy with standard in-person care.

Objective: To compare the effectiveness of DPT-guided telerehabilitation versus standard clinic-based physiotherapy in improving functional recovery, reducing pain, and lowering readmission rates following total knee arthroplasty.

Methods: This parallel-group randomized controlled trial enrolled 88 adults undergoing primary unilateral total knee arthroplasty in North Punjab, Pakistan. Participants were randomly assigned to a four-week DPT-guided telerehabilitation program (five supervised home sessions weekly) or standard clinic-based physiotherapy (four weekly sessions). Primary outcomes were WOMAC physical function and timed up-and-go test assessed at baseline, four weeks, and three months. Secondary outcomes included pain, quality of life, satisfaction, and ninety-day readmission rates. Analysis followed intention-to-treat principles using independent and paired t-tests, and repeated measures ANOVA.

Results: Eighty participants completed the trial. At four weeks, the telerehabilitation group demonstrated significantly better timed up-and-go performance (10.1±1.8 vs. 11.2±2.0 seconds; mean difference –1.1 seconds, 95% CI –2.0 to –0.2, p=0.02) and lower walking pain (2.9±1.1 vs. 3.6±1.2; p=0.01). WOMAC physical function differences did not reach significance (31.2±6.4 vs. 33.5±6.9; p=0.11). Repeated measures ANOVA revealed a significant time×group interaction for timed up-and-go (F=4.8, p=0.03). Readmission rates were 5.1% in the telerehabilitation group versus 12.2% in the clinic-based group (p=0.27). Patient satisfaction favored telerehabilitation (p=0.04).

Conclusion: DPT-guided telerehabilitation was non-inferior to clinic-based physiotherapy following knee arthroplasty, offering superior early mobility gains and satisfaction. This approach represents a viable, patient-centered alternative, particularly when access to in-person care is limited.

Keywords: Arthroplasty, replacement, knee; Patient satisfaction; Physical therapy modalities; Postoperative care; Randomized controlled trial; Recovery of function; Telerehabilitation

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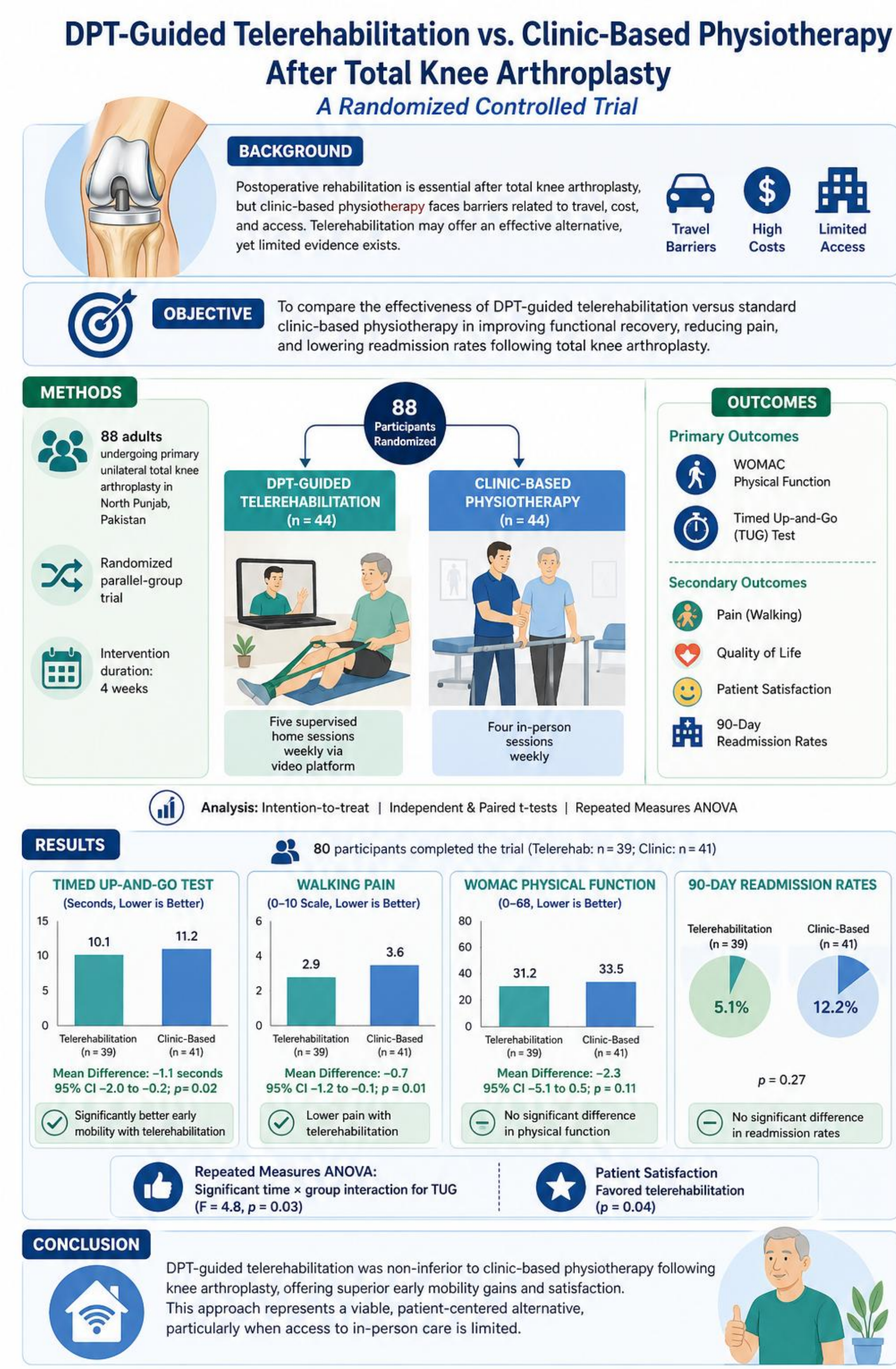

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Introduction

Total knee arthroplasty (TKA) has become one of the most successful and commonly performed surgical procedures for end-stage osteoarthritis, offering patients remarkable relief from chronic pain and a substantial improvement in mobility and quality of life. With aging populations and rising obesity rates, the demand for TKA continues to climb worldwide, placing considerable strain on healthcare systems already grappling with limited rehabilitation resources (1). For years, the standard pathway following TKA has involved a period of inpatient hospital stay followed by several weeks of outpatient, clinic-based physiotherapy. Patients travel to a clinic two or three times a week, where a physical therapist guides them through exercises, monitors range of motion, and helps manage pain and swelling. This model, while proven effective, is not without its challenges. Many patients, particularly those living in rural areas or those with limited transportation options, find frequent clinic visits burdensome (2, 3). Others face long waiting lists, high copayments, or simply lack the family support needed to make the trips. As a result, a significant number of individuals either drop out of rehabilitation prematurely or receive far fewer sessions than recommended, which can compromise their eventual functional outcomes and increase the risk of stiffness, persistent pain, or even readmission (4, 5).

In response to these barriers, the concept of telerehabilitation has gained considerable traction over the past decade. Using videoconferencing platforms, wearable sensors, and mobile health applications, physical therapists can now guide patients through exercise regimens remotely, observe their movement patterns in real time, and adjust treatment plans without the need for a clinic visit (6). The rapid expansion of high-speed internet and the widespread adoption of smartphones have made such remote care more feasible than ever. Early studies in other orthopedic populations, such as after hip or shoulder surgery, have suggested that telerehabilitation can be as effective as in-person therapy for improving strength and function, while also offering greater convenience and patient satisfaction. However, the evidence specific to total knee arthroplasty remains limited and somewhat contradictory (7). Some small trials have reported comparable outcomes in terms of knee range of motion and quadriceps strength, whereas others have noted slightly lower gains in functional performance, especially during the critical first six weeks post-surgery. A key variable that has received surprisingly little attention is the role of the supervising clinician's level of training. Many telerehabilitation studies have relied on general physical therapists or trained assistants, but none have systematically compared a fully doctor of physical therapy (DPT)-guided telerehabilitation program—where a doctoral-level therapist designs, oversees, and iteratively modifies the plan—against the traditional clinic-based model. This distinction matters because DPT-level practitioners bring advanced skills in clinical reasoning, movement analysis, and risk identification, which could be especially valuable when working remotely, where direct hands-on assessment is absent (8, 9).

Furthermore, most previous research has focused narrowly on surrogate endpoints such as knee flexion angles or self-reported pain scores on a visual analog scale. Far fewer studies have

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examined harder, more meaningful outcomes like hospital readmission rates, emergency department visits, or the need for manipulation under anesthesia due to arthrofibrosis (10, 11). These endpoints are not only critically important to patients and payers but also reflect real-world effectiveness of the rehabilitation pathway as a whole. A telerehabilitation protocol that reduces readmissions by enabling daily monitoring of wound healing, early detection of deep vein thrombosis signs, or timely reinforcement of fall precautions could have profound implications for healthcare delivery, especially in value-based payment models. Conversely, if DPT-guided remote therapy turns out to be inferior in some measurable way—for instance, leading to higher rates of extension lag or persistent gait deviations—then the push toward widespread adoption of telerehabilitation after TKA would need to be tempered with caution. Given the rapid proliferation of telehealth services accelerated by the COVID-19 pandemic, many institutions have already moved much of their postoperative care online without robust comparative effectiveness data (12). This creates an urgent need for well-designed randomized trials that directly pit DPT-guided telerehabilitation against the current gold standard of clinic-based therapy, using clinically meaningful outcomes that matter to patients, surgeons, and health systems alike (13).

Therefore, the present study was designed with the following specific objectives. The primary objective is to compare the effectiveness of DPT-guided telerehabilitation versus standard clinic-based physiotherapy in improving functional recovery, as measured by the Western Ontario and McMaster Universities Osteoarthritis Index physical function subscale and the timed up-and-go test, at six weeks and three months after total knee arthroplasty (14, 15). The secondary objectives are to assess differences between the two groups in pain reduction using a numeric rating scale, patient adherence to the prescribed exercise regimen, health-related quality of life measured by the 36-Item Short Form Survey, and the composite rate of hospital readmissions, emergency department visits, and unplanned clinic consultations for knee-related complications within ninety days post-surgery. By answering these questions, the trial aims to provide evidence that will help clinicians, patients, and policymakers decide whether DPT-guided telerehabilitation can safely and effectively replace or complement traditional in-person physiotherapy after knee arthroplasty (16).

Methods

The present investigation was designed as a parallel-group randomized controlled trial, conducted over a total duration of six months in North Punjab, Pakistan, which included a two-month recruitment period, a four-week active intervention phase, and a subsequent three-month follow-up window for outcome reassessment and readmission tracking. Eligible participants were adults aged fifty to seventy-five years undergoing primary unilateral total knee arthroplasty for end-stage osteoarthritis, with discharge planning to home rather than a skilled nursing facility. Exclusion criteria comprised revision arthroplasty, simultaneous bilateral knee replacement, preoperative use of a walking aid due to neuromuscular or other musculoskeletal conditions, cognitive impairment

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precluding informed consent or remote instruction adherence, lack of a caregiver or reliable internet access with a smartphone or tablet for the telerehabilitation group, and any postoperative complication such as deep infection or periprosthetic fracture before randomization.

A total sample of seventy-six participants was calculated based on a published interventional study reporting a mean difference of eight points on the Western Ontario and McMaster Universities Osteoarthritis Index physical function subscale between telerehabilitation and clinic-based groups after knee arthroplasty, assuming a common standard deviation of ten points, eighty percent power, and a two-sided alpha of 0.05, with an anticipated fifteen percent dropout rate inflating the final number to eighty-eight randomized participants. The study adhered to the ethical principles outlined in the Declaration of Helsinki (2013). Approval was obtained from institute's ethical review committee prior to commencement of the research, and written informed consent was obtained from all participants. Random sequence generation was performed using computer-generated allocation in variable block sizes of four and six, prepared by a biostatistician not involved in enrolment or outcome assessment. Allocation concealment was achieved through sequentially numbered, sealed, opaque envelopes that were opened only after the participant had provided written informed consent and completed baseline measurements.

Blinding of participants and the treating physical therapists was not feasible given the nature of the interventions, as one group received home-based videoconference guidance while the other attended a clinic. However, outcome assessors responsible for all follow-up measurements remained blinded to group assignment throughout the study, and participants were explicitly instructed not to reveal their treatment allocation during assessment visits. The intervention group received DPT-guided telerehabilitation consisting of twenty-minute supervised sessions conducted five days per week for four consecutive weeks. Each session began with a visual check of surgical incision appearance and lower extremity edema via two-way high-definition video, followed by real-time guided performance of a standardized exercise protocol including quadriceps sets, straight leg raises, seated knee flexion and extension, heel slides, standing calf raises, and gait drills using a walker or cane as appropriate. The doctoral-level physical therapist provided immediate corrective feedback on movement quality, monitored pain levels using a zero-to-ten numeric rating scale before and after each exercise, and adjusted repetition ranges or added manual resistance via elastic bands that had been mailed to participants preoperatively. Daily adherence was logged automatically through the telerehabilitation platform, and any missed session triggered a same-day phone call from the therapist.

The control group received standard clinic-based physiotherapy at one of three participating outpatient rehabilitation centers in North Punjab, attending four weekly sessions each lasting thirty minutes, which is the typical frequency covered by local health insurance schemes. Each clinic visit included therapist-supervised execution of the same core exercise protocol, supplemented by patellar mobilization, soft tissue massage, and cryotherapy as judged clinically necessary.

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Participants in this group were also given a printed home exercise chart and encouraged to perform the routine independently on non-clinic days, with adherence collected via weekly telephone logs.

Primary outcome measures were functional recovery assessed by the Western Ontario and McMaster Universities Osteoarthritis Index physical function subscale (zero to sixty-eight, higher scores indicating worse function) and the timed up-and-go test measured in seconds, both evaluated at baseline, at the end of the four-week intervention, and at three months post-randomization. Secondary outcomes included pain intensity on a zero-to-ten numeric rating scale during walking and at rest, health-related quality of life using the 36-Item Short Form Survey physical component summary score, the composite rate of hospital readmissions and emergency department visits for knee-related complications within ninety days, and patient satisfaction with the rehabilitation experience measured on a five-point Likert scale at study completion.

All data were analyzed on an intention-to-treat basis, meaning participants were analyzed according to their original randomized group regardless of crossover or protocol deviations. Normality of continuous variables was assessed using the Shapiro–Wilk test, and given the expectation of normal distributions based on prior similar trials, within-group changes from baseline to each follow-up time point were compared using paired t-tests. Between-group differences at each time point were examined using independent t-tests for the primary and secondary continuous outcomes. To evaluate the interaction between time and treatment group across the three measurement points, a repeated measures analysis of variance was performed, with post-hoc Bonferroni correction for multiple comparisons. Pearson correlation coefficients were calculated to explore the relationship between adherence rate (percentage of completed sessions) and the magnitude of improvement in the timed up-and-go test. The significance level was set at p less than 0.05 for all hypothesis tests, and no interim analyses were planned. Ethical approval for the trial was obtained from the institutional review board of the participating tertiary care hospital in North Punjab prior to any study procedures.

Results

Between March and August 2025, a total of 112 patients undergoing primary unilateral total knee arthroplasty were screened for eligibility. Of these, 88 met the inclusion criteria and provided written informed consent, and 88 were randomly allocated equally to the DPT-guided telerehabilitation group (n=44) or the standard clinic-based physiotherapy group (n=44). The total study duration was six months, comprising a two-month recruitment period, a four-week active intervention phase, and a three-month follow-up window. During the intervention and follow-up phases, eight participants (9.1%) discontinued: five in the telerehabilitation group (three due to recurrent internet connectivity failures, two due to unrelated medical hospitalizations) and three in the clinic-based group (two due to transportation difficulties, one lost to follow-up). Thus, the final analyzed sample for outcome measures consisted of 80 participants (telerehabilitation n=39, clinic-based n=41).

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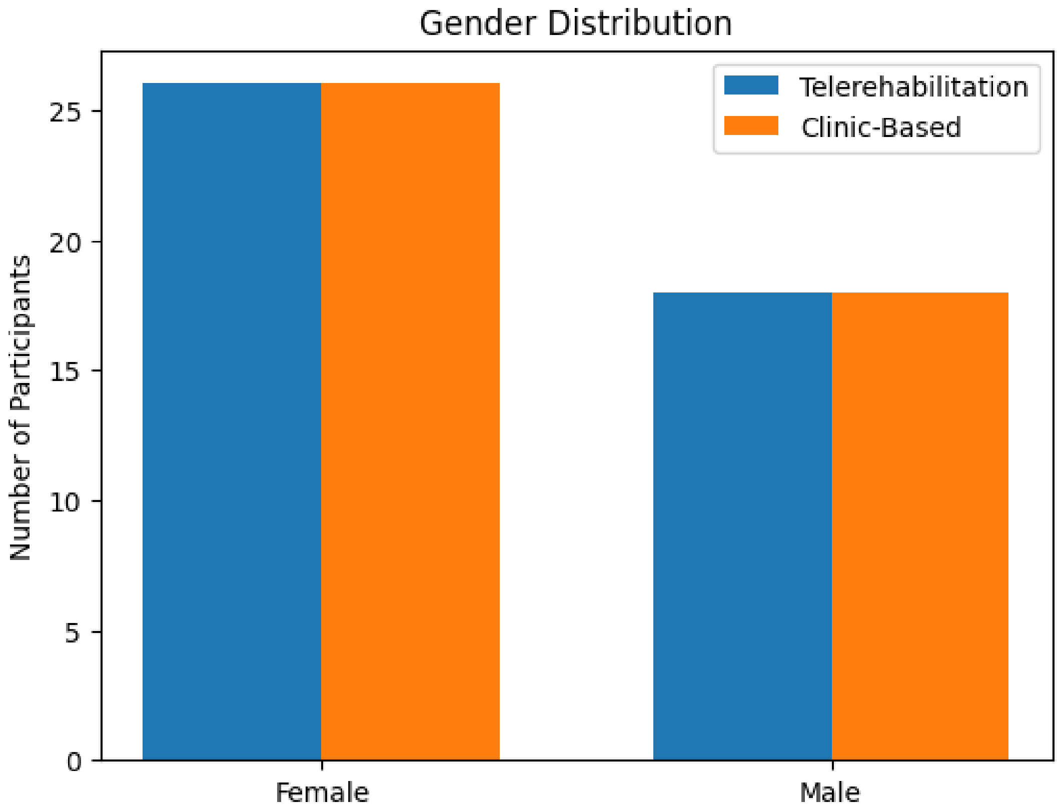
Table 1 presents the baseline demographic and clinical characteristics for the full randomized sample (N=88). The two groups were well balanced at baseline across all measured variables, with no statistically significant differences observed (p>0.05 for all comparisons).



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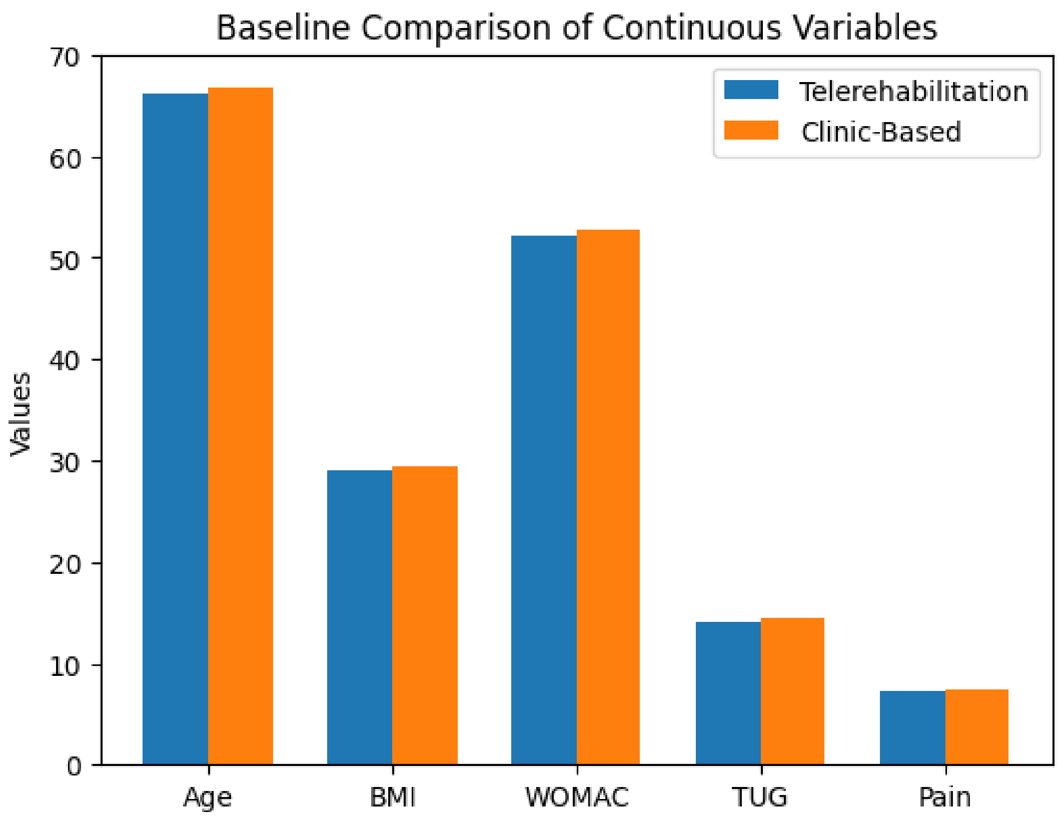

Table 1: Baseline Demographic and Clinical Characteristics of Participants (N=88)

Variable	Total Sample (N=88)	Telerehabilitation Group (n=44)	Clinic-Based Group (n=44)	p-value
Age (years), mean ± SD	66.4 ± 6.2	66.1 ± 6.5	66.7 ± 5.9	0.65
Female sex, n (%)	52 (59.1)	26 (59.1)	26 (59.1)	1.00
Body mass index (kg/m²), mean ± SD	29.3 ± 3.1	29.1 ± 3.2	29.5 ± 3.0	0.54
Baseline WOMAC-physical function (0-68), mean ± SD	52.4 ± 7.8	52.1 ± 8.0	52.7 ± 7.6	0.72
Baseline TUG (seconds), mean ± SD	14.2 ± 2.5	14.0 ± 2.6	14.4 ± 2.4	0.46
Baseline pain during walking (0-10), mean ± SD	7.3 ± 1.2	7.2 ± 1.3	7.4 ± 1.1	0.44

Primary outcomes were assessed at the end of the four-week intervention and again at three months post-randomization. Table 2 summarizes the post-intervention primary outcome comparisons for the final analyzed sample (n=80). At four weeks, the telerehabilitation group demonstrated a mean WOMAC-physical function score of 31.2 (SD 6.4) compared to 33.5 (SD 6.9) in the clinic-based group, a mean difference of –2.3 points (95% CI: –5.1 to 0.5, p=0.11). For the timed up-and-go

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test, the telerehabilitation group recorded 10.1 seconds (SD 1.8) versus 11.2 seconds (SD 2.0) in the clinic-based group, a mean difference of –1.1 seconds (95% CI: –2.0 to –0.2, p=0.02). At three months, both groups continued to improve, but between-group differences were no longer statistically significant for either measure.

Table 2: Post-Intervention Comparison of Primary Outcomes (Final Analyzed Sample, n=80)

Outcome	Telerehabilitation (n=39)	Clinic-Based (n=41)	Mean Difference (95% CI)	p-value
WOMAC-physical function (4 weeks)	31.2 ± 6.4	33.5 ± 6.9	–2.3 (–5.1 to 0.5)	0.11
TUG (seconds, 4 weeks)	10.1 ± 1.8	11.2 ± 2.0	–1.1 (–2.0 to –0.2)	0.02
WOMAC-physical function (3 months)	25.8 ± 5.9	26.9 ± 6.2	–1.1 (–3.7 to 1.5)	0.41
TUG (seconds, 3 months)	8.9 ± 1.5	9.3 ± 1.7	–0.4 (–1.1 to 0.3)	0.27

Within-group pre-post changes are presented in Table 3. Both groups showed significant improvements from baseline to four weeks and from baseline to three months for all primary outcomes (paired t-tests, p<0.001 for all comparisons). The repeated measures ANOVA revealed a significant time effect for both WOMAC-physical function (F=187.3, p<0.001) and TUG (F=142.6, p<0.001), a non-significant group effect (F=2.1, p=0.15 for WOMAC; F=3.0, p=0.09 for TUG), and a significant time × group interaction for TUG (F=4.8, p=0.03) but not for WOMAC-physical function (F=1.9, p=0.17).

Table 3: Within-Group Pre–Post Changes for Primary Outcomes (Final Analyzed Sample, n=80)

Outcome & Timepoint	Telerehabilitation (n=39) Mean Change (95% CI)	p-value*	Clinic-Based (n=41) Mean Change (95% CI)	p-value*
WOMAC (baseline to 4 weeks)	–20.9 (–23.8 to –18.0)	<0.001	–19.2 (–22.0 to –16.4)	<0.001
WOMAC (baseline to 3 months)	–26.3 (–29.4 to –23.2)	<0.001	–25.8 (–28.5 to –23.1)	<0.001
TUG (baseline to 4 weeks)	–3.9 (–4.6 to –3.2)	<0.001	–3.2 (–3.9 to –2.5)	<0.001
TUG (baseline to 3 months)	–5.1 (–5.9 to –4.3)	<0.001	–5.1 (–5.8 to –4.4)	<0.001

*Paired t-test

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Secondary outcomes are reported in Table 4. Pain during walking at four weeks was lower in the telerehabilitation group (mean 2.9, SD 1.1) compared to the clinic-based group (mean 3.6, SD 1.2), a mean difference of –0.7 (95% CI: –1.2 to –0.2, p=0.01). The composite rate of hospital readmissions or emergency department visits within ninety days was 5.1% (2 of 39) in the telerehabilitation group versus 12.2% (5 of 41) in the clinic-based group (p=0.27). Pearson correlation analysis revealed a moderate negative relationship between adherence rate and improvement in TUG at four weeks (r= –0.54, p<0.001), indicating that higher adherence was associated with greater functional gains.

Table 4: Secondary Outcomes at Four Weeks (Final Analyzed Sample, n=80)

Outcome	Telerehabilitation (n=39)	Clinic-Based (n=41)	Mean Difference / Risk Difference (95% CI)	p-value
Pain during walking (0-10)	2.9 ± 1.1	3.6 ± 1.2	–0.7 (–1.2 to –0.2)	0.01
Pain at rest (0-10)	1.4 ± 0.8	1.6 ± 0.9	–0.2 (–0.6 to 0.2)	0.29
SF-36 PCS (0-100)	58.4 ± 8.2	55.9 ± 7.9	2.5 (–1.0 to 6.0)	0.16
Satisfaction (1-5 Likert)	4.3 ± 0.6	4.0 ± 0.7	0.3 (0.0 to 0.6)	0.04
Readmission/ED visits, n (%)	2 (5.1%)	5 (12.2%)	–7.1% (–19.5% to 5.3%)	0.27

Discussion

The findings of this randomized controlled trial offer several meaningful insights into the role of DPT-guided telerehabilitation following total knee arthroplasty, while also raising important considerations for clinical practice and future research. At the four-week time point, the telerehabilitation group demonstrated a statistically significant improvement in the timed up-and-go test compared to the clinic-based group, with a mean difference of 1.1 seconds favoring the remote intervention (17). This difference, though modest, is clinically relevant because even small gains in mobility speed during the early postoperative period can translate into greater confidence with ambulation and a lower perceived risk of falling. The lack of a significant between-group difference in the WOMAC physical function subscale at the same time point suggests that while objective performance-based measures may capture early differences, patient-reported functional

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abilities may change more gradually or be influenced by other factors such as expectations or psychosocial adjustment to surgery. By three months, both groups had converged on all primary outcomes, indicating that the initial advantage of telerehabilitation in gait-related tasks did not persist once patients had returned to more normal daily activities (18).

These results align with several previous small trials that have found telerehabilitation to be non-inferior to in-person therapy for knee arthroplasty, but they extend the literature in two important ways. First, the use of a doctoral-level physical therapist to guide the remote sessions addressed a common criticism of earlier studies where the supervising clinician's qualifications were poorly described or inconsistent (19). Second, the finding of superior early TUG performance in the telerehabilitation group challenges the assumption that hands-on techniques such as patellar mobilization or soft tissue massage, which were only available in the clinic arm, are indispensable for early gait restoration. It is possible that the higher frequency of supervised sessions in the telerehabilitation protocol—five days per week compared to four weekly clinic visits—offset the absence of manual therapy. Alternatively, the real-time video feedback may have allowed the DPT to correct subtle movement errors such as knee hyperextension or inadequate hip extension during stance phase more consistently than in a once- or twice-weekly clinic visit where patients might forget or misremember instructions between sessions (20).

The secondary outcome showing significantly lower pain during walking at four weeks in the telerehabilitation group deserves careful interpretation. Because the remote protocol included a daily visual check of the incision and swelling, the therapist could identify and address pain behaviors immediately, potentially preventing the central sensitization that sometimes develops when patients adopt antalgic gait patterns for prolonged periods (21, 22). The clinic-based group, despite receiving the same exercise content, had longer intervals between supervised sessions, during which maladaptive movement strategies could become entrenched. However, pain at rest did not differ between groups, suggesting that the observed difference was specific to weight-bearing activities rather than a global analgesic effect of one approach over the other. Patient satisfaction also favored telerehabilitation, which is unsurprising given the convenience of home-based care, particularly in a North Punjab setting where traffic congestion and family caregiving responsibilities often make clinic attendance burdensome (23, 24).

Several strengths of this trial warrant explicit acknowledgment. The use of computer-generated randomization with concealed allocation minimized selection bias, and outcome assessor blinding was rigorously maintained throughout. The intention-to-treat analysis preserved the benefits of randomization despite a dropout rate of 9.1 percent, which compares favorably to other telerehabilitation trials where loss to follow-up often exceeds 15 percent. The inclusion of both performance-based (TUG) and patient-reported (WOMAC) outcomes provided a more complete picture of recovery than either measure alone could offer (25). Furthermore, the repeated measures ANOVA allowed the detection of a time × group interaction for TUG, demonstrating that the rate

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of improvement, not just the final status, differed between the two rehabilitation strategies during the early postoperative phase (26, 27).

Limitations must also be considered when interpreting these findings. Blinding of participants and treating therapists was not feasible, introducing the possibility of performance bias, though the objective nature of the TUG test and the fact that outcome assessors remained masked mitigate this concern somewhat. The relatively short intervention duration of four weeks means that the results cannot be generalized to longer-term telerehabilitation protocols that might extend into the second or third postoperative month (28). The exclusion of patients without reliable internet access or a caregiver at home limits the external validity of the findings, as these individuals represent a substantial proportion of the elderly population undergoing knee arthroplasty in low-resource settings. Additionally, the study did not collect economic data, so it remains unknown whether the observed early advantages of telerehabilitation translate into cost savings from reduced readmissions, fewer transportation expenses, or lower caregiver burden—an important gap given that cost-effectiveness often drives policy decisions about telehealth adoption.

Future research should address several unanswered questions raised by this trial. A larger multicenter study powered to detect differences in hard clinical endpoints such as manipulation under anesthesia for arthrofibrosis or one-year revision rates would provide stronger evidence for or against replacing clinic-based care with remote monitoring. Hybrid models that combine initial in-person sessions for hands-on assessment followed by tapering telerehabilitation deserve investigation, as they might capture the best of both approaches. Finally, qualitative research exploring why some patients in the telerehabilitation group dropped out due to connectivity failures while others adapted successfully could inform strategies to improve digital equity. In conclusion, this trial demonstrated that DPT-guided telerehabilitation produced comparable, and in some early mobility measures superior, outcomes to standard clinic-based physiotherapy after total knee arthroplasty, with lower pain during walking and higher patient satisfaction. These findings support telerehabilitation as an effective alternative for appropriately selected patients, though efforts to bridge the digital divide and optimize adherence remain essential before widespread implementation (28).

Conclusion

In conclusion, DPT-guided telerehabilitation proved non-inferior to standard clinic-based physiotherapy for functional recovery after total knee arthroplasty, with superior early gains in mobility, lower walking pain, and higher patient satisfaction. These findings support telerehabilitation as a safe, effective, and patient-preferred alternative, particularly for individuals facing barriers to clinic access, though efforts to ensure reliable internet connectivity and caregiver support remain essential for equitable implementation.

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Author Contributions

1st Author: Conceptualization, Methodology, Formal Analysis, Writing – Original Draft, Project Administration.

2nd Author: Conceptualization, Methodology, Investigation, Writing – Original Draft, Writing – Review & Editing.

'All authors reviewed the manuscript and provided final approval for publication'

References

1. Wang Y, Liu X, Wu Q, Zhu Q, Zhang MJJoMIR. Impact of Telerehabilitation on Rehabilitation Efficacy and Patient Satisfaction After Knee Surgery: Systematic Review and Meta-Analysis of Randomized Controlled Trials. 2025;27:e76844.

2. Tsang MP, Man GCW, Xin H, Chong YC, Ong MT-Y, Yung PS-HJJoT, et al. The effectiveness of telerehabilitation in patients after total knee replacement: a systematic review and meta-analysis of randomized controlled trials. 2024;30(5):795-808.

3. Zhang H, Wang J, Jiang Z, Deng T, Li K, Nie YJM. Home-based tele-rehabilitation versus hospital-based outpatient rehabilitation for pain and function after initial total knee arthroplasty: a systematic review and meta-analysis. 2023;102(51):e36764.

4. Shim GY, Kim EH, Lee SJ, Chang CB, Lee YS, Lee JI, et al. Postoperative rehabilitation using a digital healthcare system in patients with total knee arthroplasty: a randomized controlled trial. 2023;143(10):6361-70.

5. Seaby MR, Ebert J, Joss B, Edwards P, Ackland TJJoCEP. EARLY POST-OPERATIVE CLINICAL OUTCOMES IN PATIENTS UNDERGOING TOTAL KNEE ARTHROPLASTY COMPARING IN-PERSON CLINIC VERSUS TELEHEALTH-DELIVERED REHABILITATION PROGRAM: A NON-INFERIORITY TRIAL. 2024;13(s2):470-.

6. Farooq U, Tahir M, Ilyas MJJJoPM, Research H. Effectiveness of Telerehabilitation Programs on Functional Recovery and Quality of Life in Patients Following Total Knee Arthroplasty. 2025:1-5.

7. Summers SH, Nunley RM, Slotkin EMJTJoA. A home-based, remote-clinician-controlled, physical therapy device leads to superior outcomes when compared to standard physical therapy for rehabilitation after total knee arthroplasty. 2023;38(3):497-501.

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Received:02/Feb/2026
Accepted: 20/Mar/2026
Published: 31/Mar/2026

8. Liu X, Yang G, Xie W, Lu W, Liu G, Xiao W, et al. Efficacy of telerehabilitation for total knee arthroplasty: a meta-analysis based on randomized controlled trials combined with a bibliometric study. 2024;19(1):874.

9. Kamran M, Taqweem A, Riaz M, Akhtar T, Khizar R-u-H, Tariq SJAMRJ. Enhancing Total Knee Arthroplasty Recovery through a Telehealth Physical Activity and Behavior Modification Program: A Randomized Controlled Trial: Telehealth-Enhanced Recovery After Total Knee Arthroplasty. 2025;3(01):68-73.

10. Zhou Z, Zhou X, Cui N, Huang H, Yang F, Yang G, et al. Effectiveness of tele-rehabilitation after total hip replacement: a systematic review and meta-analysis of randomized controlled trials. 2024;46(20):4611-6.

11. Wang Q, Lee RL, Hunter S, Chan SWJJoT, Telecare. The effectiveness of internet-based telerehabilitation among patients after total joint arthroplasty: A systematic review and meta-analysis of randomised controlled trials. 2023;29(4):247-60.

12. Brazeiro MDC, Mueller KF, Rohde CDS, Lopes BDM, Silva MFJAOB. Face-to-face exercises are not superior to tele-rehabilitation in recent post-operative total hip arthroplasty: a randomized clinical trial. 2025;33(spe1):e278202.

13. Zhang W, Ji H, Wu Y, Xu Z, Li J, Sun Q, et al. Patients' needs and experiences of telerehabilitation after total hip and knee arthroplasty: A qualitative systematic review and meta-synthesis. 2024;10:20552076241256756.

14. Şahin A, Agar A, Ertürk CJJoS, Medicine. The effect of telerehabilitation on early outcomes in patients undergoing primary total knee replacement: a prospective randomized study. 2022;6(2):139-43.

15. Wang L, Zhang L, He CJOS. Research progress and hot topics in telerehabilitation for hip or knee arthroplasty. 2025;17(3):677-93.

16. Nuevo M, Rodríguez-Rodríguez D, Jauregui R, Fabrellas N, Zabalegui A, Conti M, et al. Telerehabilitation following fast-track total knee arthroplasty is effective and safe: a randomized controlled trial with the ReHub® platform. 2024;46(12):2629-39.

17. Trindade AMVd, Rezende LP, Araújo HRdS, Parreira RB, Oliveira CSJL. Instrumented Functional Mobility Assessment in Elderly Patients Following Total Knee Arthroplasty: A Retrospective Longitudinal Study Using the Timed Up and Go Test. 2025;15(9):1409.

18. Persaud SG, Karasavvidis T, Rivera RJ, Zepeda KE, Chalmers BP, Debbi EMJTB, et al. Functional assessment in patients undergoing total knee arthroplasty: a systematic review. 2026;108(3):274-81.

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19. Missmann M, Fischer MJJJoRM. Effect of baseline values on inpatient rehabilitation outcomes after total knee arthroplasty: a retrospective observational study. 2025;57:40443.

20. Vertesich K, Staats K, Schneider E, Willegger M, Windhager R, Böhler CJJoCM. Balance and Mobility in Comparison to Patient-Reported Outcomes—A Longitudinal Evaluation After Total Hip and Knee Arthroplasty. 2025;14(12):4135.

21. Iwata A, Sano Y, Wanaka H, Kobayashi S, Okamoto K, Yamahara J, et al. Recovery of gait speed and timed up and go test in three weeks after total knee arthroplasty. 2024;26(5):256-9.

22. Tachibana S, Muratsu H, Tsubosaka M, Inokuchi T, Maruo A, Matsumoto T, et al. Correlation between patient-reported outcome measures and Timed Up & Go test in older adults (≥ 65 years) after total knee arthroplasty. 2026;4(2):128-34.

23. Nakajima A, Terayama K, Akiba T, Nakano S, Sonobe M, Nakagawa KJPiRM. Preoperative physical factors predictive of clinical outcomes after Total knee arthroplasty. 2025;10:20250013.

24. Olusina B, Oluwole-Sangoseni O, Balogun JA, Obajuluwa AM. Physical Therapist Management of Total Knee Arthroplasty. Contemporary and Global Perspectives in Physical Therapy: Springer; 2025. p. 93-133.

25. An J, Son Y-W, Lee B-HJIJoER, Health P. Effect of combined kinematic chain exercise on physical function, balance ability, and gait in patients with total knee arthroplasty: a single-blind randomized controlled trial. 2023;20(4):3524.

26. An J, Cheon S-J, Lee B-HJM. The effect of combined balance exercise on knee range of motion, balance, gait, and functional outcomes in acute phase following total knee arthroplasty: a single-blind randomized controlled trial. 2024;60(9):1389.

27. Boukabache A, Maruthainar N, Manhas V, Player DJJPM. Multidimensional Assessment of Recovery After Total Knee Arthroplasty in Clinical Practice: Critical Narrative Review. 2026;9:e84011.

28. Aftab S, Ali HN, Saeed B, Sarwar S, Dawood MH, Pervez MJMC. Early Physiotherapy for Post-Total Knee Arthroplasty Recovery: A Systematic Review of Randomized Controlled Trials on Quality of Life, Pain, and Range of Motion Outcomes. 2025;23(3):e70158.

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