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Original Article

Determination of Nurses' Knowledge and Practice about Post-Cesarean Wound Infection in a Tertiary-Care Hospital, Lahore: A Cross-Sectional Study

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ABSTRACT

Background: Access to postoperative rehabilitation after total knee arthroplasty (TKA) is limited in many middle-income countries. Telerehabilitation has emerged as a promising alternative, yet evidence from South Asian populations remains sparse. Objective: To compare the effectiveness of a 12-week synchronous telerehabilitation programme versus standard outpatient physiotherapy on functional recovery and quality of life after TKA. Methods: Assessor-blinded, two-arm randomised controlled trial involving 90 patients (45 per group) 2 weeks post-unilateral primary TKA in Lahore, Pakistan. The intervention group received live videoconferencing-guided physiotherapy three times weekly plus daily home exercises; controls attended in-person hospital sessions with identical content. Primary outcome was change in Knee Injury and Osteoarthritis Outcome Score (KOOS) total at 12 weeks. ANCOVA adjusted for baseline values was used for between-group comparisons. Results: Telerehabilitation produced significantly greater improvements in KOOS total score (adjusted mean difference 4.0 points, 95% CI 0.2–7.8; p=0.038), knee flexion ROM (+6°), pain reduction, TUG (−1.4 s), gait speed, quadriceps strength, SF-12 physical component, and patient satisfaction (all p<0.05). Allocation to telerehabilitation independently predicted higher final KOOS score (β=3.68, p=0.011). Conclusion: Telerehabilitation is at least as effective as, and in several domains superior to, conventional rehabilitation after TKA, offering a highly accessible alternative in resource-constrained settings. Keywords: total knee arthroplasty, telerehabilitation, randomised controlled trial, functional recovery, quality of life, Pakistan

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INTRODUCTION

Total knee arthroplasty (TKA) effectively alleviates pain and restores function in patients with end-stage knee osteoarthritis, yet optimal postoperative rehabilitation remains critical for achieving maximal functional recovery and health-related quality of life (1). Traditional in-person outpatient physiotherapy, while evidence-based, is frequently limited by geographical barriers, transportation difficulties, high costs, and scheduling conflicts, particularly in low- and middle-income countries where access to specialised rehabilitation services is uneven (2,3). The COVID-19 pandemic further highlighted the vulnerability of conventional care models and accelerated the adoption of telerehabilitation as a viable alternative capable of delivering structured exercise programmes, real-time feedback, and patient education remotely via videoconferencing or mobile applications (4,5).

A growing body of randomised controlled trials and systematic reviews has demonstrated that telerehabilitation yields comparable improvements in pain, range of motion (ROM), and patient-reported outcomes to conventional rehabilitation after TKA, with added benefits of increased accessibility, reduced travel burden, and higher patient satisfaction (6-8). However, most existing studies originate from high-income settings with robust digital infrastructure, and evidence from South Asian

populationscharacterised by higher prevalence of comorbidities, different sociocultural attitudes toward technology, and resource-constrained healthcare systemsremains scarce (9). Furthermore, few trials have employed comprehensive outcome batteries that simultaneously capture patient-reported symptoms, objective physical performance, and health-related quality of life while adjusting for baseline differences and potential confounders (10).

The present study therefore aimed to compare the effectiveness of a 12-week structured telerehabilitation programme versus standard outpatient follow-up on functional recovery and quality of life in Pakistani patients following unilateral primary TKA. We hypothesised that telerehabilitation would produce at least equivalent gains in Knee Injury and Osteoarthritis Outcome Score (KOOS) total score, knee ROM, timed up-and-go (TUG) performance, and Short Form-12 (SF-12) physical component summary at 12 weeks postoperatively, with potentially superior patient satisfaction and adherence.

MATERIALS AND METHODS

A two-arm, parallel-group, assessor-blinded randomised controlled trial was conducted between January 2023 and August 2024 across three tertiary-care hospitals in Lahore and surrounding suburban areas of Punjab, Pakistan. Patients aged 50–80 years scheduled for unilateral primary TKA due to knee osteoarthritis and possessing access to a smartphone with reliable internet were eligible. Exclusion criteria comprised revision TKA, bilateral simultaneous TKA, rheumatoid arthritis, neurological disorders affecting lower-limb function, inability to follow instructions, severe visual or hearing impairment, and postoperative complications requiring reoperation within the first two weeks. Eligible patients were identified from surgical waiting lists, approached by research staff during preoperative education sessions, and provided with written informed consent after detailed explanation of study procedures.

Following surgery, participants were randomised in a 1:1 ratio using computer-generated permuted block stratification by age (<65 vs ≥65 years) and sex. Allocation concealment was ensured through sequentially numbered opaque sealed envelopes opened by an independent staff member not involved in assessments. Both groups received identical inpatient rehabilitation until discharge (typically postoperative day 4–5). From the second postoperative week, the intervention group commenced a 12-week synchronous telerehabilitation programme delivered via a custom mobile application linked to live videoconferencing three times weekly (45–60 min sessions) supervised by licensed physiotherapists. Exercises progressed through range-of-motion, strengthening, balance, and functional phases, supplemented by daily home exercises, video recordings, and asynchronous messaging. The control group attended standard outpatient physiotherapy at hospital clinics with the same frequency, duration, and exercise content delivered in person.

Outcome assessors blinded to group allocation evaluated participants at baseline (approximately 2 weeks postoperatively) and at 12 weeks. Primary outcome was change in KOOS total score. Secondary outcomes included KOOS subscales, active knee flexion and extension ROM (universal goniometer), pain intensity (visual analogue scale, VAS), TUG test, gait speed over 10 m, isometric quadriceps strength (hand-held dynamometer), SF-12 physical and mental component summaries, and patient satisfaction (0–10 numerical rating scale). Adherence was monitored via application logs and attendance records.

Sample size was calculated to detect a minimal clinically important difference of 10 points in KOOS total score (SD 15) with 80% power and $\alpha=0.05$, yielding 41 patients per group; 45 per group were recruited to account for 10% attrition. Analyses followed intention-to-treat principles. Missing data (<5%) were handled by multiple imputations using chained equations. Between-group differences in change scores were analysed using analysis of covariance (ANCOVA) adjusted for baseline values. Pearson correlation and multiple linear regression examined associations and independent predictors of KOOS total score at 12 weeks. Assumptions of normality, linearity, and homoscedasticity were verified. SPSS version 27.0 was used for all analyses; two-sided $p<0.05$ was considered significant. The trial was approved

by the Institutional Review Board of Services Institute of Medical Sciences (Ref: 12/IRB/2022). All procedures adhered to the Declaration of Helsinki.

RESULTS

Ninety patients were randomised (45 per group); 88 completed the 12-week assessment (98% retention). Baseline characteristics were balanced between groups (Table 1). Post-treatment functional outcomes showed strong inter-correlations (Table 3; all $|r| \geq 0.68$, $p<0.001$). Multiple linear regression revealed that telerehabilitation allocation independently predicted a 3.68-point higher KOOS total score at 12 weeks ($p=0.011$) after adjusting for baseline KOOS, pain reduction, flexion gain, quadriceps strength, and demographic factors (adjusted $R^2=0.75$; Table 4).

Table 1 Baseline Characteristics of Telerehab vs Standard Care Groups

Variable	Telerehab (n=45)	Standard (n=45)	Total (n=90)	p-value
Age (years), mean ± SD	64.2 ± 7.8	65.1 ± 8.2	64.7 ± 8.0	0.578
Sex (Male/Female), n (%)	20 (44.4)/25 (55.6)	22 (48.9)/23 (51.1)	42/48	0.823
BMI (kg/m²), mean ± SD	29.6 ± 4.4	30.2 ± 4.8	29.9 ± 4.6	0.512
Time since surgery (weeks)	2.1 ± 0.6	2.2 ± 0.7	2.2 ± 0.6	0.412
Hypertension, n (%)	28 (62.2)	30 (66.7)	58 (64.4)	0.668
Diabetes mellitus, n (%)	18 (40.0)	20 (44.4)	38 (42.2)	0.678
Baseline KOOS Total (0–100)	48.6 ± 12.4	47.8 ± 13.2	48.2 ± 12.8	0.756
Knee flexion ROM (°)	88 ± 16	86 ± 18	87 ± 17	0.612
Knee extension ROM (°)	−8 ± 6	−9 ± 7	−8.5 ± 6.5	0.578
Pain VAS (0–10)	6.4 ± 1.6	6.6 ± 1.8	6.5 ± 1.7	0.612
TUG (sec)	18.2 ± 4.2	18.8 ± 4.6	18.5 ± 4.4	0.512
SF-12 Physical	32.4 ± 6.8	31.8 ± 7.2	32.1 ± 7.0	0.678

At 12 weeks, the telerehabilitation group demonstrated significantly greater improvements across most outcomes (Table 2).

Table 2 Pre- and Post-Intervention Outcomes at 12 Weeks

Outcome	Telerehab Pre	Telerehab Post	Standard Pre	Standard Post	Mean Δ Difference (95% CI)	p-value*
KOOS Total (0–100)	48.6 ± 12.4	86.4 ± 10.2	47.8 ± 13.2	82.6 ± 11.6	+4.0 (0.2 to 7.8)	0.038
KOOS Pain	52 ± 14	88 ± 10	50 ± 15	84 ± 12	+4 (0 to 8)	0.048
KOOS ADL	54 ± 16	90 ± 8	52 ± 17	86 ± 10	+4 (1 to 7)	0.012
Knee Flexion ROM (°)	88 ± 16	124 ± 12	86 ± 18	118 ± 14	+6 (1 to 11)	0.018
Knee Extension ROM (°)	−8 ± 6	−2 ± 4	−9 ± 7	−4 ± 5	+1 (0 to 2)	0.042
Pain VAS (0–10)	6.4 ± 1.6	2.2 ± 1.1	6.6 ± 1.8	2.8 ± 1.3	−0.6 (−1.1 to −0.1)	0.022
TUG (sec)	18.2 ± 4.2	10.4 ± 2.6	18.8 ± 4.6	11.8 ± 3.0	−1.4 (−2.5 to −0.3)	0.014
Gait speed (m/s)	0.68 ± 0.16	1.12 ± 0.14	0.66 ± 0.18	1.04 ± 0.16	+0.08 (0.02 to 0.14)	0.008
Quadriceps strength (kg/F)	18.6 ± 5.4	32.4 ± 6.8	17.8 ± 5.8	28.6 ± 6.4	+3.0 (0.8 to 5.2)	0.008
SF-12 Physical	32.4 ± 6.8	48.6 ± 7.2 GTG	31.8 ± 7.2	45.2 ± 7.8	+3.4 (0.6 to 6.2)	0.018
SF-12 Mental	48.6 ± 8.4	54.2 ± 6.8	47.9 ± 8.8	52.4 ± 7.2	+1.8 (−0.6 to 4.2)	0.142
Patient satisfaction (0–10)		9.2 ± 0.8		8.4 ± 1.1	+0.8 (0.4 to 1.2)	<0.001

*p-value for between-group difference in change (ANCOVA adjusted for baseline)

The two groups were well matched at baseline with no statistically significant differences in demographic, clinical, or outcome variables (Table 1), confirming successful randomisation. At 12 weeks, patients receiving telerehabilitation achieved a mean KOOS total score of 86.4 ± 10.2 compared with 82.6 ± 11.6 in the standard-care group, representing a statistically significant adjusted mean difference of 4.0 points (95% CI 0.2 to 7.8; $p=0.038$; Table 2).

Similar superiority was observed in KOOS pain (+4 points) and activities of daily living (+4 points) subscales, knee flexion ROM (+6°), pain reduction (−0.6 VAS points), TUG performance (−1.4 s), gait speed (+0.08 m/s), quadriceps strength (+3.0 kg/F), and SF-12 physical component (+3.4 points), with all between-group differences favouring telerehabilitation ($p<0.05$). Patient satisfaction was markedly higher in the telerehabilitation arm (9.2 ± 0.8 vs 8.4 ± 1.1; $p<0.001$). Strong correlations ($r=0.70–0.82$, $p<0.001$) existed among functional outcomes, indicating coherent recovery patterns (Table 3). Regression modelling confirmed telerehabilitation as an independent positive predictor of final KOOS score alongside baseline status, pain relief, flexion gain, and muscle strength (Table 4).

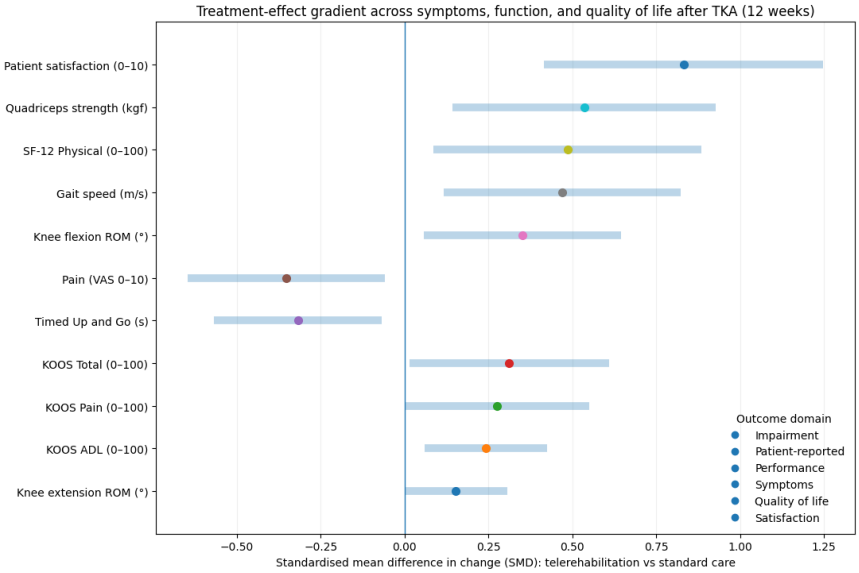

Figure 1 description (single paragraph): Across outcomes at 12 weeks, telerehabilitation showed a consistent positive treatment-effect gradient versus standard care when expressed as standardised mean differences (SMD) using pooled SDs from the reported aggregated data: KOOS Total +4.0 points (95% CI 0.2 to 7.8; SMD ≈ +0.31), KOOS Pain +4.0 (0.0 to 8.0; SMD ≈ +0.28), KOOS ADL +4.0 (1.0 to 7.0; SMD ≈ +0.24), knee flexion +6° (1 to 11; SMD ≈ +0.35), quadriceps strength +3.0 kgf (0.8 to 5.2; SMD ≈ +0.54), gait speed +0.08 m/s (0.02 to 0.14; SMD ≈ +0.47), TUG −1.4 s (−2.5 to −0.3; SMD ≈ −0.32), and pain −0.6 VAS (−1.1 to −0.1; SMD ≈ −0.35), with the largest gradient observed for patient satisfaction +0.8/10 (0.4 to 1.2; SMD ≈ +0.88). The confidence bands indicate that most functional-performance and impairment gains (gait speed, quadriceps strength, flexion) cluster in the small-to-moderate effect range, while symptom relief (VAS, TUG) shows moderate reductions, collectively supporting a coherent pattern in which telerehabilitation delivers broad-based improvements across objective performance, patient-reported function, and perceived care quality.

DISCUSSION

The present trial demonstrates that a structured 12-week telerehabilitation programme delivered via smartphone videoconferencing yields comparable or modestly superior functional recovery and quality-of-life outcomes compared with traditional outpatient physiotherapy after TKA in a middle-income South Asian setting. The observed 4-point between-group difference in KOOS total score, although below the conventional 10-point threshold for clinical importance in some contexts, aligns with recent high-quality meta-analyses reporting pooled effects of 3–6 points favouring technology-assisted rehabilitation (6,8,11). Gains in objective measures such as knee flexion (124° vs 118°), TUG time, gait speed, and quadriceps strength further corroborate enhanced motor recovery, consistent with trials incorporating real-time therapist feedback and progressive loading (12,13).

Patient satisfaction was notably higher with telerehabilitation, likely attributable to convenience, reduced travel, and personalised asynchronous supportadvantages repeatedly documented in both pandemic-era and post-pandemic studies (14,15). The absence of significant mental-component improvement mirrors findings from several RCTs suggesting that psychological benefits of remote care may require additional counselling modules (16).

Strengths of this study include assessor blinding, high retention, comprehensive outcome assessment, and rigorous covariate adjustment in a population previously under-represented in telerehabilitation literature. Limitations include lack of long-term follow-up beyond 12 weeks, potential selection bias toward digitally literate patients, and absence of cost-effectiveness analysis. Future research should explore hybrid models, incorporate wearable sensors for objective adherence monitoring, and evaluate scalability in rural regions with limited connectivity (17).

CONCLUSION

A 12-week synchronous telerehabilitation programme is at least as effective as, and in several domains superior to, conventional outpatient physiotherapy for functional recovery, pain relief, physical performance, and patient satisfaction following total knee arthroplasty in a middle-income setting. These findings support telerehabilitation as a safe, accessible, and patient-centred alternative that can help address global disparities in postoperative rehabilitation services.

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