

The Impact of Telerehabilitation on Patients with Knee Osteoarthritis: A Comparative Study

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ABSTRACT: This study seeks to assess and compare the impacts of telerehabilitation and home-based exercise programs on individuals diagnosed with moderate/mild knee osteoarthritis (KOA). Patients meeting the criteria for moderate/mild KOA were included in the study and randomly assigned to two groups. The telerehabilitation group engaged in guided exercises through video conferences with a physiotherapist, whereas the control group received a brochure illustrating the exercises. Participants underwent assessments using the 30-s chair stand test (30 CST), Knee Injury and Osteoarthritis Outcome Score (KOOS), Numeric Rating Scale (NRS), International Physical Activity Questionnaire Short Form (IPAQ-SF), and Hospital Anxiety and Depression Scale (HADS) at two points in time—before and after an 8-week treatment period. Additionally, the quantity of painkillers consumed by patients within the last 15 days was documented both before and after the treatment.

Keywords: Telerehabilitation, Knee, Osteoarthritis, Depression, Injury, Anxiety.

INTRODUCTION

Knee osteoarthritis (KOA) is a prevalent degenerative joint ailment that impacts the articular cartilage, resulting in pain, stiffness, and diminished mobility. It stands as a major contributor to disability, affecting a substantial number of individuals globally (Arden and Leyland 2013). Individuals grappling with KOA commonly contend with pain, fatigue, depression, anxiety, fear of movement, physical inactivity, and reduced muscle strength, all of which significantly compromise their quality of life. To impede the progression of OA, lifestyle adjustments involving physical exercises and self-management are universally recommended (Xie *et al.*, 2020). Nevertheless, the effective implementation of these strategies faces challenges due to the absence of professional supervision and feedback. The advent of telemedicine has introduced telerehabilitation as a promising solution, seamlessly integrating telemedicine and rehabilitation interventions to provide sustained rehabilitation services for patients.

Method: This study took place in the Physiotherapy Department of Surya Hospital in Pipar city, Jodhpur, spanning from September 2022 to April 2023. Participants diagnosed with mild to moderate knee osteoarthritis (KOA) were enrolled, with inclusion criteria comprising the ability to walk unaided, ownership of an internet-enabled device, and the capability to use the device independently. Exclusion criteria included diagnoses of other systemic rheumatic diseases, participation in physiotherapy and rehabilitation programs within the last 6 months, knee-related surgery, cognitive issues, among others. A total

of 100 patients meeting the criteria were included and randomly assigned to treatment and control groups.

The treatment group engaged in exercises via video conference, guided by a physiotherapist, while the control group received a brochure illustrating the exercises. Participants were educated on downloading the Zoom Meetings application for physical performance tests and telerehabilitation in the treatment group. Meeting identification numbers and passcodes were communicated to ensure participation. The treatment group utilized the application 24 times for telerehabilitation, excluding assessments, while the control group used it only during the baseline evaluation and after 8 weeks. Post-evaluation, all patients received educational sessions through Zoom Meetings.

The treatment regimen for both groups included knee and hip exercises in various positions, chair sit-ups, isometric contractions, leg raises, squats, standing on one leg, and stretching exercises. The duration and repetitions increased weekly. Telerehabilitation sessions occurred three times a week for 45–60 minutes over 8 weeks, guided by a physiotherapist. Conversely, the control group independently performed the exercises.

Tools: The 30-second chair stand test (30 CST) served as a pivotal assessment tool for evaluating lower extremity muscle strength and dynamic balance. In this test, participants, seated on a chair without arm or back support and positioned at an average height of 44 cm from the floor, were required to sit and stand for 30 seconds. The chair, with its back against the wall, aimed to prevent any sliding during the test. To facilitate optimal performance, participants were

instructed to position their feet further back than the knee joint, ensuring contact with the ground for swifter transitions between sitting and standing. Crossed arms over the shoulders, individuals underwent two attempts, with the number of repetitions recorded as the score.

The Physical Activity Readiness Questionnaire for Everyone, comprising 48 questions, played a vital role in assessing participants' readiness for physical activity. The questionnaire, inclusive of preliminary and additional questions, utilized yes and no response options. Individuals responding "no" to the initial seven questions were encouraged to become more physically active under the guidance of physicians.

The Knee Injury and Osteoarthritis Outcome Score (KOOS) questionnaire, which comprises five subgroups, was employed to evaluate patients' physical functioning, encompassing pain, symptoms, functional status in daily activities, sports and leisure activities, and knee-related quality of life. Pain severity was assessed using the Numeric Rating Scale (NRS), a semi-quantitative method. The International Physical Activity Questionnaire Short Form (IPAQ-SF) gauged physical activity levels, while the Hospital Anxiety and Depression Scale (HADS) measured symptoms of depression and anxiety.

Supplementary assessments encompassed the TAMPA Kinesiophobia Scale (TKS), the Exercise Adherence Rating Scale (EARS), the Fatigue Severity Scale (FSS), and patient satisfaction with treatment, gauged through a 5-point Likert scale. Data analysis was conducted using SPSS 24.0. A multiple regression analysis was performed to explore the relationship between post-intervention outcome measures, treated as independent variables, and group assignment (telerehabilitation or control group), treated as the dependent variable. Covariates, including pre-intervention outcome measures, were incorporated into the analysis. The significance level for all analyses conducted was set at $p < 0.05$.

RESULTS

The study comprised a cohort of 50 patients, with no noteworthy distinctions identified in baseline characteristics between the groups. Following the 8-week follow-up, the telerehabilitation group exhibited superior outcomes in the 30 CST, IPAQ-SF, KOOS, and a more substantial reduction in NRS and HADS scores compared to the control group. Significantly, all specified parameters demonstrated a statistically significant difference between the telerehabilitation and control groups.

Table 1: Comparison of baseline and sociodemographic characteristics.

Characteristics	Telerehabilitation (n = 50)	Control (n = 50)	p-value
Age (in years)	55.87 ± 7.24	55.79 ± 6.76	0.768
Sex, No (%):			
Female	43 (86.0%)	45 (90.0%)	0.572
Male	7 (14.0%)	5 (10.0%)	
BMI, kg/m ²	32.59 ± 5.40	32.16 ± 6.76	0.687
Working Status:			
Working	10 (20.0%)	10 (20.0%)	1.000
Non-working	40 (80.0%)	40 (80.0%)	
Disease Duration, years	5.72 ± 3.49	5.87 ± 4.16	0.461
Painkillers in Last 15 Days	2.62 ± 2.90	3.16 ± 3.14	
30 CST (30-second Chair Stand Test)	10.29 ± 2.86	10.66 ± 2.23	0.823
NRS (Numeric Rating Scale)	5.25 ± 2.38	5.58 ± 2.18	0.589
KOOS (Knee Injury and Osteoarthritis Outcome Score):			
Symptoms	66.79 ± 17.69	59.41 ± 25.81	0.129
Pain	55.12 ± 20.90	49.54 ± 22.71	0.139
Functional Status-Daily Living Activities	59.87 ± 21.71	51.54 ± 27.68	0.236
Functional Status-Sports and Leisure Activities	32.50 ± 25.91	36.25 ± 31.21	0.364
Knee-related QoL (Quality of Life)	39.87 ± 16.55	40.75 ± 23.61	0.561
Total	51.04 ± 17.89	45.70 ± 24.27	0.142
HADS (Hospital Anxiety and Depression Scale):			
Anxiety	8.54 ± 3.92	8.62 ± 3.60	0.762
Depression	5.83 ± 2.88	6.20 ± 3.17	0.432
Total	14.37 ± 5.03	15.83 ± 5.96	0.459
TAMPA Kinesiophobia	41.58 ± 4.28	44.08 ± 6.77	0.149
FSS (Fatigue Severity Scale)	5.07 ± 1.01	5.26 ± 1.44	0.762
IPAQ-SF (International Physical Activity Questionnaire Short Form), MET-min/week:			
Total	569.25 ± 613.27	647.14 ± 637.14	0.421
IPAQ-SF, Category:			
High	0 (0%)	0 (0%)	0.261
Moderate	16 (32.0%)	14 (28.0%)	
Low	34 (68.0%)	36 (72.0%)	

Table 2: Comparison of mean difference between both groups.

Variable	Telerehabilitation Group (Pre-Post Mean Differences)	Control Group (Pre-Post Mean Differences)	Mean Differences	p-value
Painkillers in last 15 days	2.41 [(1.28) to (3.54)]	0.50 [(-0.23) to (1.23)]	-4.62 [(-.32) to (- 2.92)]	< 0.001
30 CST	-7.04 [(- 8.10) to (5.91)]	-1.41 [(- 2.13) to (0.070)]	5.25 [(4.18) to (6.31)]	< 0.001
NRS	4.66 [(3.68) to (5.64)]	-1.75 [(- 2.73) to (-0.76)]	-3.83 [(- 5.10) to (2.56)]	< 0.001
KOOS Symptoms	-20.83 [(- 28.53) to (- 13.13)]	-7.45 [(- 16.36) to (1.44)]	24.75 [(12.90) to (36.59)]	< 0.001
KOOS Pain	-32.50 [(- 40.82) to (- 24.17)]	-10.12 [(- 21.17) to (0.92)]	30.95 [(18.77) to (43.14)]	< 0.001
KOOS Functional status—daily living activity	-30.95 [(- 39.93) to (21.98)]	-11.75 [(- 23.35) to (4.123)]	29.54 [(17.07) to (42.01)]	< 0.001
KOOS Functional status—sports and leisure activity	-42.70 [(- 52.33) to (33.08)]	-8.75 [(- 19.24) to (1.74)]	30.20 [(14.08) to (46.33)]	< 0.001
KOOS Knee related QoL	-29.54 [(- 35.99) to (23.09)]	-4.70 [(- 14.16) to (4.74)]	23.95 [(11.28) to (36.63)]	< 0.001
KOOS Total	-30.95 [(- 37.87) to (- 24.04)]	-8.62 [(- 17.84) to (0.59)]	27.66 [(15.44) to (39.88)]	< 0.001
HADS Anxiety	4.25 [(2.41) to (6.08)]	1.70 [(0.55) to (2.86)]	-2.62 [(- .37) to (- 0.87)]	0.004
HADS Depression	3.12 [(1.87) to (4.37)]	1.79 [(0.72) to (2.86)]	-2.70 [(- .21) to (- 1.19)]	0.001
HADS Total	7.37 [(4.88) to (9.86)]	3.58 [(1.97) to (5.19)]	-5.33 [(- .20) to (- 2.46)]	0.001
TAMPA Kinesio-	6.54 [(3.34) to (9.74)]	4.25 [(1.00) to (7.49)]	-4.79 [(- 8.21) to (1.36)]	0.007
FSS	2.11 [(1.56) to (2.66)]	0.39 [(- 0.08) to (0.86)]	-1.91 [(- .62) to (- 1.20)]	< 0.001
IPAQ-SF, MET min/week	-656.33 [(- 067.17) to (- 245.48)]	-183.66 [(- 450.93) to	394.77 [(19.05) to (770.48)]	0.040

DISCUSSION

Until now, a significant portion of Knee Osteoarthritis (KOA) patients has unfortunately remained sedentary without proper support for increasing physical activity. Engaging in a physically active lifestyle has been associated with reduced pain and improved physical function. As a result, there is a need for accessible and effective physiotherapy programs. This study was designed to assess the effectiveness of telerehabilitation and the quality of physiotherapy for KOA patients (Dunlop *et al.*, 2011).

The objective was to investigate the impact of telerehabilitation on physical performance, pain, functional status, emotional well-being, kinesiophobia, fatigue, and physical activity levels in KOA patients. Additionally, we aimed to evaluate exercise compliance, treatment satisfaction, and the quality of physiotherapy received. The study revealed positive improvements in these parameters for the telerehabilitation group (Dunlop *et al.*, 2011).

The literature indicates a higher incidence of KOA in women compared to men (Loeser *et al.*, 2016), consistent with the gender distribution in our study. The majority of participants were females in both telerehabilitation and control groups, aligning with previous research (Kloek *et al.*, 2018; Nero *et al.*, 2017). KOA, a significant cause of disability in adults over 50, poses a threat to quality of life and independence (Wright *et al.*, 2010). In our study, the mean age of participants in both groups was over 50, consistent with similar literature (Dahlberg *et al.*, 2016).

Obesity and being overweight are recognized as serious risk factors for KOA. Our study participants in both

groups could be classified as obese based on BMI. This aligns with findings in the literature, emphasizing the impact of obesity on KOA (Umapathy *et al.*, 2015).

Pain, a prevalent symptom in KOA, was assessed using the Numeric Rating Scale (NRS). Both groups exhibited similar pain intensity before treatment. However, the telerehabilitation group showed a statistically significant reduction in pain intensity compared to the control group after treatment. Regular and correct exercise, facilitated through simultaneous video conferences with a physiotherapist, likely contributed to this difference (Bennell *et al.*, 2014).

The number of painkillers used in the last 15 days decreased significantly in the telerehabilitation group, while the control group exhibited a non-significant decrease. The telerehabilitation group showed a statistically significant greater reduction in painkiller usage compared to the control group (Nero *et al.*, 2017).

Physical function, evaluated using the 30-Second Chair Stand Test (30 CST), improved significantly in both groups post-treatment. However, the increase in the telerehabilitation group was clinically significant and statistically higher than the control group. The structured exercises performed with guidance through video conferences likely contributed to this improvement (Baker *et al.*, 2001).

Functional status, assessed with the Knee Injury and Osteoarthritis Outcome Score (KOOS), showed a statistically significant improvement in the telerehabilitation group across all sub-parameters, while the control group exhibited significant improvement only in the functions in daily living activities sub-parameter. The telerehabilitation group demonstrated

significantly better scores in functional status compared to the control group (Allen *et al.*, 2018).

Emotional status, evaluated using the Hospital Anxiety and Depression Scale (HADS), showed significant improvements in both groups post-treatment. However, the telerehabilitation group exhibited significantly better emotional status compared to the control group.

Kinesiophobia, measured with the Tampa Scale for Kinesiophobia (TKS), decreased significantly in both groups after treatment. The telerehabilitation group showed a significantly greater reduction in kinesiophobia compared to the control group.

Fatigue, assessed with the Fatigue Severity Scale (FSS), significantly improved in the telerehabilitation group post-treatment, while the control group exhibited a non-significant change. The telerehabilitation group showed significantly better fatigue scores compared to the control group.

Physical activity levels, measured using the International Physical Activity Questionnaire-Short Form (IPAQ-SF), significantly improved in the telerehabilitation group post-treatment, with no significant change in the control group. The telerehabilitation group demonstrated significantly higher physical activity levels compared to the control group (Allen *et al.*, 2018).

CONCLUSIONS

This study suggests that telerehabilitation surpasses self-management in effectiveness. Utilizing an innovative and tailored web-based approach for knee osteoarthritis (KOA) extends the reach to a significant number of patients with internet access, ensuring the delivery of effective treatment. Subsequent research endeavors should concentrate on refining and broadening the application of telerehabilitation for the management of KOA.

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Conflict of Interest. None.

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