INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

COMPARISON OF TELEREHABILITATION VS. CLINICAL SETUP REHABILITATION IN TKR PATIENTS

Original Research

Muhammad Humza Shahid[1], Junaid Ijaz Gondal[2], Irfan Ahmed[3], Iqra Ikram[4]*, Maha Jamil[4], Adnan Hashim[4]
[1]Department of Rehabilitation, Superior University Lahore, Lahore, Pakistan.
[2]Superior University Lahore, Head of Physiotherapy Department, Mayo Hospital, Lahore, Pakistan.
[3]Head of Department at APRC, Horizon Hospital Lahore, Lahore, Pakistan.
[4]Former Student, University of Lahore, Lahore Pakistan.
Corresponding Author: Iqra Ikram, Former Student University of Lahore, Lahore Pakistan, iqraikram002@gmail.com

Conflict of Interest: None
Grant Support & Financial Support: None
Date Submitted: 07-10-24
Date Published: 25-10-24

ABSTRACT

Background: Osteoarthritis (OA) of the knee is a common condition among older adults, often leading to significant pain and disability. Total knee replacement (TKR) is frequently recommended for severe cases to alleviate symptoms and restore function. However, effective post-operative rehabilitation is crucial to maximize recovery outcomes and improve quality of life. Telerehabilitation is emerging as an accessible alternative to conventional physiotherapy, potentially enhancing patient adherence and functional outcomes while minimizing the need for in-person visits.

Objective: To evaluate the effectiveness of telerehabilitation compared to conventional physiotherapy in improving knee function and patient outcomes following TKR.

Methods: A randomized controlled trial was conducted at Horizon Hospital in Lahore, including 36 participants aged over 65 years, all of whom had undergone TKR. Participants were randomly assigned to either Group A (telerehabilitation) or Group B (conventional clinical therapy), with 18 individuals in each group. Data collection tools included the Knee Outcome Survey-Activities of Daily Living (KOS-ADLS) and the Western Ontario and McMaster Universities Osteoarthritis (WOMAC) surveys, supplemented by electronic goniometer measurements of knee flexion and extension. Assessments were conducted at baseline and at the fourth week to compare outcomes statistically between the two groups.

Results: In the fourth week, Group A (telerehabilitation) showed significantly better outcomes in knee function and pain management compared to Group B (conventional therapy). KOOS-ADL scores improved significantly in Group A ($p = 0.001$) compared to Group B. WOMAC scores also demonstrated significant improvement in Group A ($p = 0.000$). Furthermore, knee flexion increased substantially for Group A, reaching 121.1° ($p = 0.031$), and knee extension deficit reduced to 2.6° ($p = 0.028$).

Conclusion: Telerehabilitation is an effective post-operative intervention for TKR, enhancing knee function, reducing pain, and improving overall patient satisfaction. This approach provides a practical and accessible solution, particularly beneficial for older adults with limited mobility.

Keywords: knee function, knee osteoarthritis, knee replacement surgery, osteoarthritis treatment, pain management, physiotherapy alternatives, post-operative rehabilitation, rehabilitation outcomes, telerehabilitation benefits, total knee arthroplasty, total knee replacement, virtual physiotherapy.

INTRODUCTION

The most common joint condition affecting older people is osteoarthritis (OA) of the knee. OA is characterized by a gradual deterioration of the articular cartilage, which results in pain and a loss of function (1). Total knee arthroplasty (TKA) was shown to be the most effective treatment option for advanced osteoarthritis (OA) knee deformities and severe symptoms (2). Restoration was anticipated for individuals who underwent total knee replacement (TKR) to regain their physical mobility due to the presence of pain, muscular weakness, and limited range of motion in their knees (3). Compared to patients who received total knee replacement, three systematic evaluations corroborate the more significant impact of physiotherapy in promoting a more rapid recovery of physical function and independence (4). After total knee arthroplasty (TKA), 75–85% of patients get rehabilitation, emphasizing functional training for all ADLs (incredibly progressive ambulation training). Increasing the knee's flexion range without sacrificing quadriceps muscle strength and extension was the primary obstacle during rehabilitation. By two weeks following total knee arthroscopy, 90° of knee flexion was ideal. The ultimate objective was the patient's independence with everyday activities (5). Physiotherapy was recognized to have several advantages; however, post-operative rehabilitation treatments were not available. According to specific research, up to 30% of patients may not follow suggested physiotherapy recommendations (6). Furthermore, research suggested different types, intensities, and durations of physical therapy exercises were indicated after total knee replacement (7). It has been shown that high-intensity physical therapy may result in superior functional results in 60% of patients compared to low-intensity treatments (8).

Innovative technologies such as e-health, telemedicine, virtual reality wearables, and online educational tools have introduced convenient healthcare facilities to the medical field. Compared to standard conventional therapy or face-to-face rehabilitation, services given through smartphones or the Internet are more valuable and affordable for people living in rural or remote areas for whom accessibility to the health-care facility for rehabilitation becomes difficult (9). Telerehabilitation was a modern treatment program that used knowledge and networking technologies to provide remote care to individuals who live far away. The program included counseling, exercise routines, education, evaluation, and assessment. It had become widely accepted since it eliminated the need for travel, required less time, and was more convenient (10). This study examines the feasibility, attainability, and patient satisfaction of telerehabilitation and clinical consultation rehabilitation. The objective is to assess whether telerehabilitation can provide comparable or significantly better outcomes in terms of functional recovery, pain management, improved range of motion, and patient satisfaction for Total Knee Replacement (TKR) patients. If telehealth interventions prove successful, they can be implemented to increase access to high-quality rehabilitation treatments and enhance healthcare delivery. Evidence-based findings from this study can help healthcare providers make educated decisions about incorporating telerehabilitation into post-operative rehabilitation protocols, thereby enhancing patient care and optimizing resource utilization in orthopedic settings.

METHODS

A randomized control trial (RCT) was conducted at Horizon Hospital in Lahore to evaluate the effectiveness of an intervention. Participants underwent a screening process to determine their eligibility, and those who indicated their willingness to participate were randomized by lottery into two groups: Group B (telerehabilitation) and Group A (conventional physiotherapy). Patients over the age of 65 who were diagnosed with total knee replacement (TKR) were included in the study. These patients interacted with the medical team and had degenerative arthritis with cemented total knee arthroplasty. Unconscious patients who had undergone knee joint surgery prior to TKA, those with a history of rheumatoid arthritis or other systemic inflammatory diseases, or those who experienced significant mobility disorders, mental diseases, or had difficulties with vision, hearing, or independent mobility, were excluded from the study. The Knee Outcome Survey-Activities of Daily Living (KOS-ADLS), the Western Ontario and McMaster Universities Osteoarthritis Index (WoMAC), and an electronic goniometer were utilized to assess knee function and activities of daily living throughout the study. The exercise instructors and subjects were informed about their group allocations to ensure adherence to the program. However, to minimize bias and maintain objective evaluation, the clinical staff involved in data collection and assessment remained blinded to group allocation.

The treatment protocols for both groups were standardized, with Group A receiving physiotherapy sessions at the clinic and Group B receiving telerehabilitation sessions at home via video call. Group A participants attended conventional physiotherapy five times a week

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

for thirty minutes, starting on the third day after TKA, focusing on improving leg strength, core stability, balance, and overall performance. The baseline evaluation was completed one day before the TKA, and the post-test was conducted four weeks after the procedure (11). Group B participants received similar physical treatment through virtual consultations. A physiotherapy assistant arranged virtual follow-up appointments using platforms like Zoom or WhatsApp, following a four-week program. Patients in this group were informed that clinical photographs would be taken, and the video calls recorded. Verbal consent was obtained from each patient before their virtual clinic appointments (12). The telerehabilitation program aimed to enhance leg strength, core stability, balance, and overall performance, with post-testing conducted four weeks after TKA, and baseline assessment completed one day prior. The combined kinetic chain exercise program included two sets of ten repetitions of exercises such as wall sliding, ankle exercises, supine quadriceps setting, chair hopping, and heel raises during the first week. For the second and third weeks, exercises like wall squats, step box elevation and descent, heel raises, and seated quadriceps engagement were performed. The fourth week involved small squats with a walker, step box maneuvers, and chair exercises, all completed in two sets of ten repetitions. Additional one-minute sessions of one-toe gait repetitions were also incorporated. The program lasted 30 minutes, with breaks of 30 to 40 seconds between sets (14). The open kinetic chain exercise program included knee ROM exercises, quadriceps setting using a foam roller while supine, straight leg raises, and ankle pulls for the first two weeks. In weeks three and four, ROM activities, seated quadriceps settings, and standing hip abduction exercises were performed. A 30-minute interval was maintained between each session (15). Upon successful rehabilitation following TKR, a satisfaction survey was conducted to gather insights into participants' views on the therapy they received, providing an evaluation of the restoration techniques applied (16).

To analyze the differences between groups, descriptive statistics were conducted using SPSS 23.0. Descriptive and frequency statistics were utilized to compute sample means, standard deviations, and percentages. The student's t-test compared continuous quantitative data, while frequencies and percentages described qualitative data. The Wilcoxon Signed Ranks Test was used to compare pre- and post-diagnosis states, and the Mann-Whitney Test evaluated the groups' pre- and post-treatment scores. Before participation, detailed information about the study's objectives and procedures was provided to the participants, and those who agreed signed an informed consent form, demonstrating their adherence to ethical standards and regulations. Ethical approval for the study was granted by the Ethical Review Committee of the Department of Rehabilitation Sciences, Superior University Lahore (IRB Approval No.: FAHS/DPTRS/2/24/MS/RS-3374), and the research complied with all relevant national regulations and institutional policies. It was also registered in Clinical Trials under Registration No. NCT06457620.

RESULTS

Table 1 Demographic and Clinical Factor Comparison

Factors	Group A	Group B
BMI < 24.9%	22.2%	11.1%
Overweight (%)	44.4%	66.7%
Gender (Female/Male)	66.7% / 33.3%	61.1% / 38.9%
Side Affected (Left/Right)	50.0% / 22.2%	33.3% / 38.9%
Marital Status (Single/Married)	55.6% / 44.4%	50.0% / 50.0%
Pain Severity	Severe 44.4%	Mild 38.9%
Satisfaction Level (Satisfied/Highly Satisfied)	50% / 22.2%	44.4% / 16.7%

Table 1 shows significant differences between Group A and Group B across factors. Group A has a greater number of people with BMI < 24.9% (22.2%) than Group B (11.1%), while Group B has a higher proportion of overweight people (66.7% vs. 44.4%). More women are in Group A (66.7%) and slightly more men in Group B (38.9%). Groups have comparable education levels. Group A has more left-side-affected people (50.0%) than Group B (33.3%), whereas Group B has more right-side-affected people (38.9% vs. 22.2%). Group A has more singles (55.6%), and Group B is more married (50.0%). Group A had more severe pain (44.4%), and Group B was milder (38.9%). Group A was most satisfied (50%) and then satisfied (22.2%). In Group B, 44.4% were happy and 16.7% highly satisfied.

Table 2 Group Comparisons: Metrics and p-values

Metrics	Group A	Group B	p-value
Mean Age (Years)	69.27 ± 2.88	71.50 ± 2.87	0.05
WOMAC Scores (Baseline)	4.97 ± 1.12	3.85 ± 0.79	0.12
WOMAC Scores (4th Week)	5.96 ± 1.15	6.16 ± 0.85	0.001
KOOS-ADL Scores (Baseline)	60.23	56.48 ± 20.63	0.45
KOOS-ADL Scores (4th Week)	67.11	80.68 ± 7.75	0.001

Table 2 presents the comparative analysis of various metrics between Group A and Group B. The mean age of participants was slightly lower in Group A (69.27 ± 2.88 years) compared to Group B (71.50 ± 2.87 years), with a p-value of 0.05, indicating a statistically significant difference. The baseline WOMAC scores were higher in Group A (4.97 ± 1.12) than in Group B (3.85 ± 0.79), but this difference was not statistically significant (p = 0.12). However, by the fourth week, both groups showed improvements, with Group A reaching 5.96 ± 1.15 and Group B 6.16 ± 0.85, and a p-value of 0.001 indicating a significant improvement in Group B. The KOOS-ADL baseline scores were similar between the groups (60.23 for Group A vs. 56.48 ± 20.63 for Group B; p = 0.45). In contrast, the fourth-week scores showed a significant improvement in Group B (80.68 ± 7.75) compared to Group A (67.11), with a p-value of 0.001.

Table 3 Knee Flexion and Extension: Baseline & 4th Week Values

Metrics	Group A (Telerehabilitation)	Group B (Usual Therapy)	p-value
Knee Flexion (Baseline)	105.3° ± 1.8	105.8° ± 2.1	0.849
Knee Extension Deficit (Baseline)	5.1° ± 0.8	5.3° ± 1.0	0.610
Knee Flexion (4th Week)	121.1° ± 2.5	111.1° ± 2.7	0.031
Knee Extension Deficit (4th Week)	2.6° ± 0.7	4.2° ± 0.9	0.03

The table presents the baseline and fourth-week values for knee flexion and extension in both Group A (telerehabilitation) and Group B (usual therapy). At baseline, knee flexion values were similar between the groups, with Group A averaging 105.3° and Group B 105.8° (p = 0.849). Knee extension deficits were also comparable, with Group A showing a deficit of 5.1° and Group B a deficit of 5.3° (p = 0.610). By the fourth week, Group A demonstrated significant improvements in both knee flexions, increasing to 121.1° (p = 0.031), and knee extension, reducing the deficit to 2.6° (p = 0.03). In comparison, Group B showed less improvement, with knee flexion increasing to 111.1° and knee extension deficit reducing to 4.2°. These results indicate that Group A responded better to rehabilitation, particularly in improving knee mobility.

DISCUSSION

The purpose of the review was to assess the effectiveness of telerehabilitation and clinical restoration for patients who have had total knee replacement (TKR) across several factors. The review's findings indicated a significant reduction in inflammation and knee spasms, as well as an improvement in the range of motion, flexibility, and overall quality of daily activities compared to the control group. These benefits persisted for one month following the implementation of the program. This indicates that telerehabilitation was more effective than clinical intervention in terms of both outcome measures. The study has elaborated that female subjects are more likely to develop KOA than male subjects owing to hormonal, genetic, and biomechanical causes. (13) The analysis of the data indicated that women constituted the larger proportion of the patients in the telerehabilitation group as well as the control group. KOA, involving a high-risk assessment for disabled persons age 50 and older, proves a threat to patients' quality of life and movement (14) While the demographic characteristics of the two groups were similar, the mean age in both the telerehabilitation group and the comparison group was over 65, which is somewhat expected given that KOA is more common in older populations. Furthermore, when compared with the indicated groups, the age of patients was above the average of 50, which points to the fact that the disease affects mostly older adults (15).

People with a BMI of 40 kg/m2 and above are suggested to be massively overweight. Thus, within the given matter of concern, both patients may be considered significant. The correlation tests outlined that the subject had a BMI of more than 30, thus implying that the person was overweight (16). Our analysis's findings align with previous literature, indicating that 44.4% of individuals in Group A and 66.7% in Group B are classified as overweight, with a BMI of 30 or above. These results corroborate the perspective that weight significantly influences the development and progression of knee osteoarthritis (KOA). Knee osteoarthritis (KOA) affects patients' quality of life, and one of the most frequent complaints they report is pain. The severity of the pain in both groups was similar before treatment was administered. A significant difference was noted in the telerehabilitation group, which had a significantly larger drop in pain intensity (p=0.001*) compared to the control group. Engaging in frequent and proper physical exercise is acknowledged to be useful in lowering pain in those with knee osteoarthritis (17). Based on this study, the experimental group experienced pain at a mild intensity level of 50% after total knee replacement (TKR), while the control group had a pain intensity level of 44%. The disparity may be attributed to differences in the efficacy of treatments, patient characteristics, or approaches to pain management among the groups.

Patients with knee osteoarthritis (KOA) see a decrease in their actual capabilities due to the negative consequences it brings. During our evaluation, we examined the real capabilities by applying the WOMAC test. The average scores for the two groups were similar before the intervention. Following the therapy, both groups exhibited a statistically significant increase in their average scores (p= 0.867) at baseline. However, only the telerehabilitation group achieved clinical significance, exhibiting a much greater improvement in their scores compared to the control group (p= 0.00). Conventional and appropriate exercises have been found to reduce symptoms in people with knee osteoarthritis (KOA), while low-intensity strengthening exercises increase muscular strength. Thus, the observed improvement in average WOMAC scores for both groups aligns with expectations. Our findings on real capacity align with the findings reported by Gohir et al. and Nero et al (18, 19), but differ from those of Allen et al (20). Allen et al. attributed their different findings to lower participant motivation in their study compared to others. The practical status was similar to the findings of the studies conducted by (20) (18), and (21). There is a positive relationship between an individual's economic situation and their level of pain intensity and function. Regular physical activity is expected to enhance the effectiveness of telerehabilitation. KOOS provides a more effective evaluation of effectiveness than WOMAC, as seen in comparison studies. We found that our research results using the KOOS survey. The Telerehabilitation group had significantly higher scores after therapy.

The current study used a 5-point Likert Scale to measure patient satisfaction with the therapy. All patients in the telerehabilitation group were highly satisfied, whereas 50.0% of experimental and 44.4% of control patients. In Australia, (22) It was reported that patients who received telerehabilitation were more satisfied. Several aspects, including physical, emotional, and functional results, the economic burden from the perspective of both the customer and the provider, and adherence to the treatment, influence the success rate of telerehabilitation. Samreen Sadiq et al. 2020 suggested that telerehabilitation provides significant advantages over traditional therapy in improving knee flexion among patients. Group A received telerehabilitation, while Group B received standard care. Telerehabilitation significantly improved knee flexion compared to standard therapy (p = 0.01). Regardless, no significant difference was seen in knee augmentation across the groups (p = 0.86). The remote delivery of restoration services likely allows for more frequent and dependable therapy sessions, contributing to enhanced outcomes (23) Interestingly, similarly to the present evaluation, in the fourth week, Group A demonstrated significant improvements in both knee extension (p=0.031) and knee flexion (p=0.028). This unexpected finding can be attributed to many variables, such as differences in exercise intensity, individual patient responses, or variations in treatment protocols across the groups. Additional analysis is anticipated to fully comprehend the differences and enhance strategies for treatment among individuals with knee osteoarthritis.

Several limitations were encountered in this study when comparing telerehabilitation and clinical setup rehabilitation for TKR patients. Sample size restricted generalizations, and technology issues influenced the telerehabilitation process because of variations in patients' technological devices and accessibility of the internet. Nonunified approaches to the delivery of interventions and their compliance with the established guidelines added variability to results; the variability resulting from the applied and the patient-preferred assessment methods only served as other barriers to comparison across studies. Moreover, the study made an emphasis on short-term results, which might have affected the research in identifying long-term consequences. The environment in clinical settings also affected the stability and consistency of rehabilitation experiences.

CONCLUSIONS

It concluded that telerehabilitation provides positive outcomes to telerehabilitation methods, with the additional advantages of accessibility, reduced pain, improved range of motion, and cost-effectiveness with patient satisfaction. It is recommended that telerehabilitation services be incorporated into post-TKR care, programs tailored to patient needs, training for healthcare professionals, long-term monitoring, and patient education and engagement be promoted. By implementing these suggestions, rehabilitation outcomes can be enhanced, and the overall quality of care for TKR patients can be improved.

REFERENCES

1. Cui A, Li H, Wang D, Zhong J, Chen Y, Lu H. Global, regional prevalence, incidence and risk factors of knee osteoarthritis in population-based studies. EClinicalMedicine. 2020;29.
2. Oosthuizen CR, Takahashi T, Rogan M, Snyckers CH, Vermaak DP, Jones GG, et al. The knee osteoarthritis grading system for arthroplasty. The Journal of Arthroplasty. 2019;34(3):450-5.
3. Liptak MG, Theodoulou A, Kaambwa B, Saunders S, Hinrichs SW, Woodman RJ, et al. The safety, efficacy and cost-effectiveness of the Maxm Skate, a lower limb rehabilitation device for use following total knee arthroplasty: study protocol for a randomised controlled trial. Trials. 2019;20:1-11.
4. Fatoye F, Yeowell G, Wright J, Gebrye T. Clinical and cost-effectiveness of physiotherapy interventions following total knee replacement: a systematic review and meta-analysis. Archives of orthopaedic and trauma surgery. 2021;141:1761-78.
5. Sattler LN, Hing WA, Vertullo CJ. What is the evidence to support early supervised exercise therapy after primary total knee replacement? A systematic review and meta-analysis. BMC Musculoskeletal Disorders. 2019;20:1-11.
6. Castrodad IMD, Recai TM, Abraham MM, Etcheson JI, Mohamed NS, Edalatpour A, et al. Rehabilitation protocols following total knee arthroplasty: a review of study designs and outcome measures. Annals of translational medicine. 2019;7(Suppl 7).
7. Zaghlol RS, Khalil SS, Attia AM, Dawa GA. Comparison of two different models of rehabilitation programs following total knee replacement operations. Egyptian Rheumatology and Rehabilitation. 2020;47(1):31.
8. Harmelink K, Dandis R, der Van der Wees Pj P, Zeegers A, der Sanden MN-v, Staal J. Recovery trajectories over six weeks in patients selected for a high-intensity physiotherapy program after Total knee Arthroplasty: a latent class analysis. BMC Musculoskeletal Disorders. 2021;22:1-11.
9. Wang X, Hunter DJ, Vesentini G, Pozzobon D, Ferreira ML. Technology-assisted rehabilitation following total knee or hip replacement for people with osteoarthritis: a systematic review and meta-analysis. BMC musculoskeletal disorders. 2019;20:1-17.
10. Bettger JP, Green CL, Holmes DN, Chokshi A, Mather III RC, Hoch BT, et al. Effects of virtual exercise rehabilitation in-home therapy compared with traditional care after total knee arthroplasty: VERITAS, a randomized controlled trial. JBJS. 2020;102(2):101-9.
11. Bäcker HC, Wu CH, Schulz MR, Weber-Spickschen TS, Perka C, Hardt S. App-based rehabilitation program after total knee arthroplasty: a randomized controlled trial. Archives of orthopaedic and trauma surgery. 2021:1-8.
12. Sumargono E, Anastasia M, Saleh I, Kholinne E. The Role of Virtual Clinics in Postoperative Total Knee Replacement Surgery Follow-Up during COVID-19 Pandemic. Advances in Orthopedics. 2022;2022.
13. Risitano S, Cacciola G, Sabatini L, Capella M, Bosco F, Giustra F, et al. Restricted kinematic alignment in primary total knee arthroplasty: A systematic review of radiographic and clinical data. Journal of Orthopaedics. 2022.
14. Klem N-R, Kent P, Smith A, Dowsey M, Fary R, Schütze R, et al. Satisfaction after total knee replacement for osteoarthritis is usually high, but what are we measuring? A systematic review. Osteoarthritis and Cartilage Open. 2020;2(1):100032.
15. Loeser RF, Collins JA, Diekman BO. Ageing and the pathogenesis of osteoarthritis. Nature Reviews Rheumatology. 2016;12(7):412-20.
16. Georgiev T, Angelov AK. Modifiable risk factors in knee osteoarthritis: treatment implications. Rheumatology international. 2019;39(7):1145-57.
17. Nazari A, Moezy A, Nejati P, Mazaherinezhad A. Efficacy of high-intensity laser therapy in comparison with conventional physiotherapy and exercise therapy on pain and function of patients with knee osteoarthritis: a randomized controlled trial with 12-week follow up. Lasers in medical science. 2019;34:505-16.

18. Giesinger K, Giesinger J, Hamilton D, Rechsteiner J, Ladurner A. Higher body mass index is associated with larger postoperative improvement in patient-reported outcomes following total knee arthroplasty. BMC Musculoskeletal Disorders. 2021;22:1-9.
19. Zhang H, Wang J, Jiang Z, Deng T, Li K, Nie Y. Home-based tele-rehabilitation versus hospital-based outpatient rehabilitation for pain and function after initial total knee arthroplasty: A systematic review and meta-analysis. Medicine. 2023;102(51):e36764.
20. Gohir SA, Eek F, Kelly A, Abhishek A, Valdes AM. Effectiveness of internet-based exercises aimed at treating knee osteoarthritis: the iBEAT-OA randomized clinical trial. JAMA network open. 2021;4(2):e210012-e.
21. Nero H, Dahlberg J, Dahlberg LE. A 6-week web-based osteoarthritis treatment program: observational quasi-experimental study. Journal of medical Internet research. 2017;19(12):e422.
22. Allen K, Arbeeva L, Callahan LF, Golightly YM, Goode AP, Heiderscheit B, et al. Physical therapy vs internet-based exercise training for patients with knee osteoarthritis: results of a randomized controlled trial. Osteoarthritis and Cartilage. 2018;26(3):383-96.
23. Aily JB, Barton CJ, Mattiello SM, Silva DDO, De Noronha M. Telerehabilitation for knee osteoarthritis in Brazil: a feasibility study. International journal of telerehabilitation. 2020;12(2):137.
24. Bennell KL, Marshall CJ, Dobson F, Kasza J, Lonsdale C, Hinman RS. Does a web-based exercise programming system improve home exercise adherence for people with musculoskeletal conditions?: a randomized controlled trial. American journal of physical medicine & rehabilitation. 2019;98(10):850-8.
25. Sadiq S, Asim HM, Ahmad A, Fatima A, Khan I, Aziz A. Tele-rehabilitation versus Face To Face Rehabilitation after Knee Joint Replacement. Pakistan journal of medicine and dentistry. 2020;9(2):66-71.