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Comparison of Tele-Rehabilitation and In-Patient Rehabilitation on Pain and Functional Outcomes in Patients Undergoing Cemented Bi-Compartmental Knee Replacement Arthroplasty

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ABSTRACT

Background: Post-operative physiotherapy is a cornerstone in the management of patients undergoing knee replacement arthroplasty, aiming to alleviate pain, enhance joint mobility, and restore functional independence. Conventionally, rehabilitation is delivered through in-patient physiotherapy; however, logistical challenges, particularly during the COVID-19 pandemic, have necessitated the adoption of tele-rehabilitation approaches. While tele-rehabilitation offers advantages in accessibility and cost-effectiveness, its comparative efficacy relative to traditional in-patient programs remains under evaluation.

Aim: This study aimed to evaluate and compare the effects of tele-rehabilitation and conventional in-patient rehabilitation on pain and functional outcomes in patients undergoing cemented bi-compartmental knee replacement arthroplasty.

Methods: An interventional study was conducted on 30 patients, aged 45-60 years who had undergone knee replacement arthroplasty. They were divided into 2 equal groups and were given 18 sessions of physiotherapy over a period of 3 weeks. The interventions were selected as per the clinical practice guidelines published by APTA, which included range of motion, strengthening, and weight bearing exercises using tele rehabilitation in group A and in-patient rehabilitation in group B. The outcome measures were numerical pain rating scale and WOMAC scores.

Results: Data was not normally distributed so, Wilcoxon signed ranks test was applied showed a statistically significant difference in both outcome measures in both groups. *($p<0.05$)* Mann Whitney U test showed that there was no statistically significant difference in improvement between the groups. *($p=0.27$)*

Conclusion: Tele-rehabilitation constitutes a clinically effective and practical alternative to in-patient physiotherapy for patients following cemented bi-compartmental knee replacement arthroplasty. Its implementation may enhance accessibility, reduce healthcare costs, and facilitate continuity of care,

particularly in geographically remote or resource-limited settings.

Keywords: Knee replacement arthroplasty, Bi compartmental, Physiotherapy, Tele rehabilitation

INTRODUCTION

Knee osteoarthritis (OA) is a prevalent and progressive joint disorder characterized primarily by pain and functional impairment, ultimately leading to disability, reduced quality of life, and, in advanced cases, the need for joint replacement. [1] Total Knee arthroplasty is a well-established surgical intervention for alleviating symptoms of degenerative knee arthritis. [2] While total knee replacement effectively alleviates the symptoms of knee arthritis, it is associated with potential drawbacks such as altered joint biomechanics and significant intraoperative blood loss. Consequently, bi-compartmental knee arthroplasty (BKA) has emerged as an alternative surgical option. Theoretically, BKA offers the advantages of reduced intraoperative blood loss and preservation of the cruciate ligaments, thereby maintaining the native knee's physiological kinematics. [3] BKA involves resurfacing two of the three knee compartments while preserving the remaining compartment and the cruciate ligaments. Physical rehabilitation following total knee arthroplasty is a critical component of postoperative management, as it enhances functional recovery and facilitates the patient's return to routine activities. Although rehabilitation following total knee arthroplasty (TKA) is well established as beneficial compared with no postoperative rehabilitation, the relative effectiveness of specific rehabilitation interventions or their individual components remains uncertain. Identifying the most effective elements of rehabilitation is critical for optimizing clinical outcomes and minimizing preventable complications or prosthetic failures.[4] Numerous rehabilitation techniques are available, including supervised in-person exercise therapy delivered directly to the patient, while tele-rehabilitation is an innovative method that provides similar interventions remotely through information and communication technologies, either as a complement to or replacement for traditional in-person care.[5] Thus this study aims to evaluate and compare the effects of tele-rehabilitation and conventional in-patient rehabilitation on pain and functional outcomes in patients undergoing cemented bi-compartmental knee replacement arthroplasty.

MATERIALS & METHODS

This interventional study was conducted over a 6-month period from various physiotherapy outpatient departments in Ahmedabad, Gujarat, with interventions delivered through home visits and video-conference sessions. Simple random sampling with random allocation was used and 30 patients, aged 45–60 years, who had undergone unilateral cemented bi-compartmental knee replacement arthroplasty were included in the study. Institutional ethics approval was obtained and written informed consent was taken from all participants.

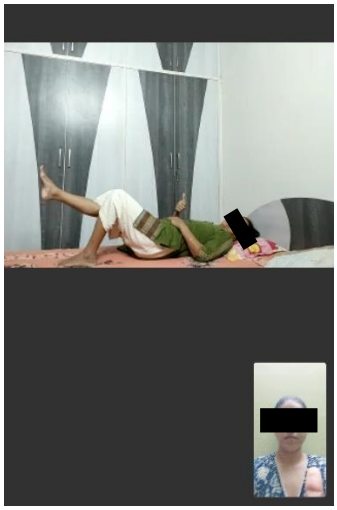
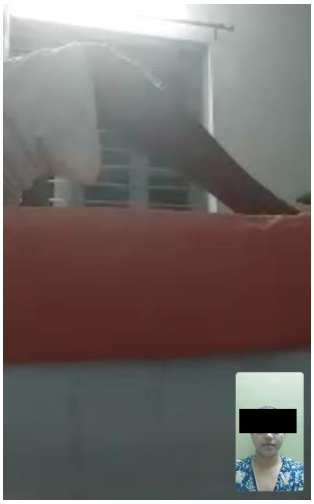
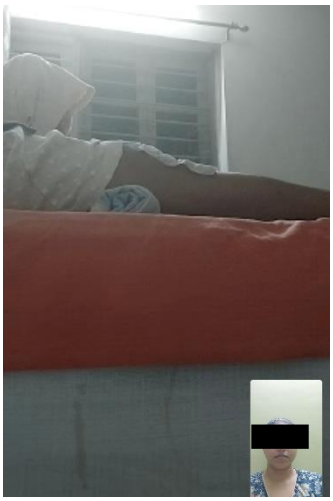
Participants of both the genders who were able to read and understand English and were willing to participate were included in the study. Exclusion criteria comprised serious medical conditions such as tumors, infections, or fractures; restricted range of motion of the spine, hip, or ankle; a history of spinal or lower-extremity surgery prior to knee arthroplasty; neurological disorders; and the use of systemic steroids within the previous six months.

Participants were randomly assigned to one of two groups. Group A received tele-rehabilitation, consisting of 18 supervised sessions delivered remotely over three weeks, while Group B underwent 18 sessions of conventional in-patient rehabilitation over the same period. All interventions were implemented according to clinical practice guidelines issued by the American Physical Therapy Association.

Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) questionnaire and the Numerical Pain Rating Scale (NPRS)were taken as outcome measures. The WOMAC is a validated, self-administered questionnaire that assesses pain, stiffness, and physical function in individuals with knee and hip osteoarthritis, providing both subscale and total scores to evaluate overall joint health and function. The NPRS is a simple 11-point scale (0–10) that measures a patient's perceived pain intensity, where 0 represents no pain and 10 represents the worst imaginable pain. These two outcome measures were used to evaluate changes in pain and functional status following the respective rehabilitation interventions.

The study Protocol applied was (Frost et al2003): Static quadriceps-5sec hold, Straight leg raising-5sec hold, Inner range quadriceps-5sec hold, Knee bending exercise in lying-5sec hold, Knee-bending exercise in standing-5sec hold, Long arc quadriceps exercise-3sec hold, Cold pack - 20mins.

Group A: Telerehabilitation

Group B: IN-PATIENT REHABILITATION




RESULTS

Data were analysed in SPSS v 22. Data was not in normal distribution by Kolmogorov Smirnov test for normality, so Wilcoxon signed ranked test was used for analysis within the group. Mann-Whitney U test was used for analysis between the groups. Mean Age for GROUP A was 53.16±6.34 and for GROUP B was 51.44±5.96. In GROUP A: Males were 7 number and females were 8. In GROUP B: Males were 9 in number and females 6.

TABLE 1: COMPARISON WITNIN THE PRE AND POST OUTCOME MEASURES OF GROUP A (TELERHABILITATION)

GROUP A	DIFFERENCE MEAN± SD	Z - VALUE	*p-value*
NPRS	2.42±1.34	3.201	0.01
WP	6.50±2.24	2.805	0.03
WST	3.21±1.42	3.101	0.03
WPFA	23.00±4.43	3.208	0.03
WA	31.64±4.55	3.101	0.02

TABLE 2: COMPARISON WITNIN THE PRE AND POST OUTCOME MEASURES OF GROUP B (IN PATIENT REHABILITATION)

GROUP B	DIFFERENCE MEAN± SD	Z - VALUE	*p-value*
NPRS	2.21+/-1.57	3.406	0.02
WP	5.35+/-2.16	2.601	0.03
WST	3.14+/-1.65	3.106	0.03
WPFA	23.85+/-4.43	4.508	0.03
WA	32.35+/-5.56	3.206	0. 01

TABLE 3: COMPARISON BETWEENN GROUP A & GROUP B FOR THE IMPROVEMENT IN OUTCOME MEASURES

GROUP A & GROUP B	DIFFERENCE MEAN± SD	U - VALUE	*p-value*
NPRS	2.31+/-1.44	86.5	0.58
WP	5.39+/-2.14	95.5	0.9
WST	3.17+/-1.51	95.6	1
WPFA	23.42+/-4.37	82.3	0.63
WA	32.00+/-5.00	74.5	0.27

DISCUSSION

Normality testing with the Kolmogorov–Smirnov test revealed that the data were not normally distributed ($p < 0.05$); therefore, non-parametric analyses were applied. The Wilcoxon signed-ranks test demonstrated statistically significant within-group improvements in pain (NPRS) and functional outcomes (WOMAC) for both the tele-rehabilitation and in-patient rehabilitation groups ($p < 0.05$). However, the Mann–Whitney U test indicated no statistically significant difference in the magnitude of improvement between the two groups ($p = 0.27$).

These findings suggest that a structured tele-rehabilitation protocol is also effective as conventional in-patient rehabilitation following cemented bi-compartmental knee arthroplasty which is in accordance with the study by Russell et al who found internet-based tele rehabilitation to yields results equivalent to standard outpatient therapy after total knee arthroplasty[2] and by Lebrun et al who demonstrated similar clinical and patient-reported outcomes with tele rehabilitation compared with traditional care.[5]

The significant within-group improvements are likely attributable to the early mobilization, progressive range-of-motion and strengthening exercises, and consistent supervision incorporated into both interventions, each following American Physical Therapy Association clinical guidelines. The exercise regimen emphasized patient education and adherence, factors shown to strongly influence post-operative recovery regardless of delivery mode.

Certain studies have proposed that face-to-face rehabilitation provides superior functional gains due to direct manual techniques and immediate feedback which is in accordance with the study conducted by Dutta et al who suggest that in-patient rehabilitation is important has it provides immediate rehabilitation in the early recovery phase. [6] The present results indicate that carefully designed tele-rehabilitation can overcome these limitations through clear instruction, regular video monitoring, and interactive feedback. The lack of between-group difference may reflect the nature of the exercises, which required minimal manual assistance and were easily performed after remote demonstration.

There was a statistically significant improvement in pain and function in the telerehabilitation group. Tousignant et al in 2011 had similar findings where knee replacement arthroplasty patients reported significant improvement in pain after telerehabilitation. [7] The effects found in the present study could be because of exercises which were easily understood by the patients by video conferencing.

There was a statistically significant improvement in pain and function in the in-

patient rehabilitation group. Frost et al, in 2002, used a similar protocol as the present study reported that exercise following knee replacement leads to improvement in pain and function due to its effects on muscular metabolism which helps the patients regain their activity level. The specific kind of knee replacement performed influences the resulting range of motion, with unicompartmental replacements generally allowing for greater postoperative flexion compared to total knee replacements.[8] While successful pain relief is the primary goal of knee replacement, patient function is also critical. Some individuals may not experience the full potential benefit of the surgery, as adequate postoperative flexion is necessary for key activities like walking and climbing stairs a study by Campbell et al. [9]

There was no statistically significant difference in the improvement in pain and function between the groups. This is in accordance with the conclusion of a systematic review done by Shukla H et al in, in which telerehabilitation was shown to be a viable alternative to face-to-face rehabilitation

Contradictory findings were reported by Choudhury et al in 2023, who concluded in a systematic review and meta-analysis that face-to-face rehabilitation showed better improvement in function and app-based telerehabilitation showed better improvement in pain. The conflicting findings in the present study could be attributed to the nature of exercises, which involved relatively lesser number of hands-on skills, which can be accurately performed by the patient under physiotherapist's supervision

This study has certain limitations. The sample size (n = 30) was modest, limiting external validity. In addition, the follow-up period was restricted to three weeks, precluding assessment of long-term outcomes. Larger, multicentre trials with extended follow-up and cost-effectiveness analyses can be done to confirm these findings and to explore patient satisfaction and adherence over time.

CONCLUSION

Tele-rehabilitation constitutes a clinically effective and practical alternative to in-patient physiotherapy for patients following cemented bi-compartmental knee replacement arthroplasty. Its implementation may enhance accessibility, reduce healthcare costs, and facilitate continuity of care, particularly in geographically remote or resource-limited settings. Tele-rehabilitation can be an alternative to in-patient rehabilitation for physiotherapy treatment post-knee replacement arthroplasty.

Declaration by Authors

Ethical Approval: Approved

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