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Effectiveness of Task-Oriented Balance Training Delivered Through Tele-Rehabilitation Versus Conventional Clinical Task-Oriented Balance Training in Stroke Patients: An Interventional Study

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Abstract: Stroke is a leading cause of long-term disability, commonly resulting in impaired balance, reduced mobility, and diminished functional independence. Task-oriented balance training is a well-established neurorehabilitation approach, and tele-rehabilitation has emerged as a promising alternative for delivering physiotherapy services. This study aimed to compare the effectiveness of task-oriented balance training delivered through a tele-rehabilitation programmed versus conventional clinical task-oriented balance training in stroke patients.

An interventional study was conducted on 52 stroke patients selected through convenience sampling. Participants were allocated into two groups of 26 each. Group A received task-oriented balance training in a clinical setting for two weeks, followed by home-based tele-rehabilitation for three weeks. Group B received conventional clinical task-oriented balance training for the full five weeks. Both groups trained for 45 minutes per session, five days per week. Outcome measures — the Berg Balance Scale (BBS), Timed Up and Go (TUG) test, and 10-Meter Walk Test (10MWT) — were assessed at baseline and post-intervention.

Both groups demonstrated statistically significant improvements in BBS, TUG, and 10MWT scores following the intervention ($p<0.001$). The mean BBS improvement was 15.31 in Group A and 14.54 in Group B, with comparable reductions in TUG and 10MWT scores. Between-group comparison revealed no statistically significant difference in improvement across all outcome measures ($p>0.05$).

Tele-rehabilitation-based task-oriented balance training is as effective as conventional clinical training in improving balance and functional mobility in stroke patients. Tele-rehabilitation may serve as a viable and accessible alternative, particularly for patients in remote or underserved settings.

Keywords: Stroke, Task-Oriented Balance Training, Tele-Rehabilitation, Berg Balance Scale, Functional Mobility.

Introduction

Stroke is one of the leading causes of mortality and long-term disability worldwide, accounting for the second highest cause of death and the third highest cause of disability globally [1]. It frequently results in impaired balance, reduced mobility, and loss of functional independence. Balance deficits following stroke significantly increase the risk of falls and limit participation in activities of daily living, thereby reducing quality of life for survivors and imposing a substantial burden on caregivers and healthcare systems [2,3].

Task-oriented balance training is a well-established neurorehabilitation approach that emphasizes goal-directed, functional activities to promote motor relearning and neuroplasticity. By incorporating meaningful tasks that simulate real-life situations, task-oriented training facilitates the transfer of skills to daily activities and enhances functional recovery [4]. Previous studies have consistently demonstrated significant improvements in balance, gait, and mobility outcomes in stroke patients following task-oriented interventions [5,6].

With advancements in digital technology, telerehabilitation has emerged as an alternative mode of delivering physiotherapy services. Tele-rehabilitation enables remote supervision, monitoring, and guidance through video conferencing and digital communication platforms, thereby improving accessibility for patients in rural or resource-limited settings [7]. Evidence suggests that telerehabilitation may produce outcomes comparable to conventional in-clinic rehabilitation for various neurological conditions including stroke [8,9]. However, while studies such as Chen et al. (2021) and Lin et al. (2014) have explored telerehabilitation for balance training in chronic stroke, direct comparisons with conventional clinical task-oriented balance training using standardized outcome measures remain limited [10,11].

Therefore, the present study aimed to compare the effectiveness of task-oriented balance training delivered through a tele-rehabilitation programme versus conventional clinical task-oriented balance training in improving balance and functional mobility among stroke patients.

Materials and Methods

Study Design

An interventional comparative study was conducted to evaluate the effectiveness of task-oriented balance training delivered through telerehabilitation versus conventional clinical training in stroke patients.

Ethical Approval

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical clearance was obtained from the Institutional Ethics Committee of Shree Devi College of Physiotherapy, Mangalore, prior to the commencement of the study. Written informed consent was obtained from all participants or their legal guardians before enrollment. Participants were assured of confidentiality and their right to withdraw from the study at any time without consequence.

Study Setting

Participants were recruited from the outpatient department of Shree Devi College of Physiotherapy, Mangalore, and Government Wenlock District Hospital, Mangalore.

Sample Size and Allocation

A total of 52 stroke patients who fulfilled the inclusion criteria were selected for the study using convenience sampling. Participants were allocated into two groups of 26 each: Group A (Tele-Rehabilitation) and Group B (Conventional Clinical Training).

Inclusion Criteria

Patients aged 45-55 years diagnosed with stroke and presenting with balance impairment were included in the study. Participants were required to be medically stable, cleared by a physician, and willing to participate in the intervention programme. Written informed consent from the participant or caregiver was mandatory for inclusion.

Exclusion Criteria

Patients without balance impairment, those with major cardiorespiratory illness, severe psychiatric illness, orthopaedic conditions affecting mobility such as fractures or dislocations, and uncooperative subjects were excluded from the study.

Intervention Protocol

Both groups received task-oriented balance training for 45 minutes per session, five days per week, for five weeks. The task-oriented programme included functional activities such as sit-to-stand transfers, stepping exercises, weight-shifting tasks, reaching in standing, tandem stance and walking, obstacle negotiation, and stair climbing practice. These tasks were graded in difficulty based on individual patient performance and progress.

Group A received supervised clinical task-oriented balance training for the first two weeks, after which the same exercise programme was continued through telerehabilitation at home for an additional three weeks using video conferencing platforms under real-time therapist supervision. Group B received conventional clinical task-oriented balance training continuously for five weeks in the clinical setting.

Outcome Measures

The following outcome measures were assessed before and after the five-week intervention period: the Berg Balance Scale (BBS), Timed Up and Go (TUG) test, and 10-Meter Walk Test (10MWT).

Berg Balance Scale (BBS)

The Berg Balance Scale is a 14-item clinician-administered scale used to assess static and dynamic balance in stroke patients. Each item is scored on a 5-point ordinal scale from 0 to 4, with a maximum total score of 56. Higher scores indicate better balance performance. Scores of 0-20 represent balance impairment, 21-40 represent acceptable balance, and 41-56 represent good balance. The BBS has demonstrated excellent reliability and validity in the stroke population [12].



Fig 1: Berg Balance Scale Measurement

Timed Up and Go (TUG) Test

The Timed Up and Go test was used to assess functional mobility and dynamic balance. Participants were seated in a standard chair with a seat height adjusted to 100% of their leg length. On the command 'go', participants rose from the chair, walked 3 metres at a comfortable pace, turned around, walked back, and sat down. The time taken to complete the task was recorded in seconds using a stopwatch. Shorter completion times indicate better functional mobility. The TUG test has been widely validated for use in stroke rehabilitation [13].

10-Meter Walk Test (10MWT)

The 10-Meter Walk Test was used to measure gait speed and functional walking ability. Participants walked a 14-metre walkway with the middle 10 metres timed, allowing 2 metres for acceleration and 2 metres for deceleration. Participants were instructed to walk at their comfortable, safe pace. The time taken to complete the 10-metre distance was recorded in seconds. The test was conducted under therapist supervision at baseline and post-intervention [14].



Fig 2: 10-Meter Walk Test Preparation

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation (SD). Within-group differences for normally distributed data were assessed using the Paired t-test. The Wilcoxon Signed Rank test was used for non-normally distributed (non-parametric) data. Between-group comparisons of improvements were performed using the Unpaired t-test. A p-value of less than 0.05 was considered statistically

significant. Statistical analysis was performed using appropriate software.

Results

A total of 52 stroke patients participated in the study, with 26 participants allocated to each group. All participants completed the five-week intervention programme without dropout.

Baseline Characteristics

The baseline demographic characteristics of the two groups were comparable. The mean age of participants in Group A was 50.27 ± 3.28 years and in Group B was 50.42 ± 3.44 years, with no statistically significant difference between the groups ($p>0.05$). Gender distribution was also comparable (Table 4).

Table 4: Baseline Demographic Characteristics of Study Participants

Characteristic	Group A (Tele-Rehab) n=26	Group B (Conventional) n=26	p-value
Mean Age (years)	50.27 ± 3.28	50.42 ± 3.44	>0.05
Gender (M/F)	15/11	14/12	>0.05

Within-Group Comparison

Both groups demonstrated statistically significant improvements in all three outcome measures following five weeks of intervention ($p<0.001$).

In Group A (Tele-Rehabilitation), the mean BBS score improved significantly from 35.27 ± 7.53 to 50.58 ± 3.88 ($p<0.001$), reflecting a mean improvement of 15.31 points. The TUG score improved from 117.62 ± 94.00 seconds to 26.08 ± 15.74 seconds ($p<0.001$), and the 10MWT time improved from 147.58 ± 106.27 seconds to 38.85 ± 19.57 seconds ($p<0.001$).

In Group B (Conventional Clinical Training), the mean BBS score improved from 35.27 ± 6.96 to 49.81 ± 4.11 ($p<0.001$), reflecting a mean improvement of 14.54 points. The TUG score improved from 132.38 ± 100.74 seconds to 29.73 ± 14.21 seconds ($p<0.001$), and the 10MWT time also demonstrated statistically significant improvement ($p<0.001$).

Between-Group Comparison

Comparison of post-intervention improvements between the two groups revealed no statistically significant difference in BBS, TUG, or 10MWT scores ($p>0.05$). The mean BBS improvement in Group A (15.31 ± 4.8) was comparable to that in Group B (14.54 ± 4.2). Similarly, improvements in TUG and 10MWT were equivalent between groups. Both tele-rehabilitation and conventional clinical training were therefore found to be equally effective in improving balance and functional mobility in stroke patients.

Table 1: Comparison of Pre- and Post-Intervention Berg Balance Scale (BBS) Scores

Group	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Mean Difference	p-value
Group A (Tele-Rehab)	35.27 ± 7.53	50.58 ± 3.88	15.31	<0.001
Group B (Conventional)	35.27 ± 6.96	49.81 ± 4.11	14.54	<0.001

Table 2: Comparison of Pre- and Post-Intervention Timed Up and Go (TUG) Scores (seconds)

Group	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Mean Difference	p-value
Group A (Tele-Rehab)	117.62 ± 94.00 s	26.08 ± 15.74 s	-91.54 s	<0.001
Group B (Conventional)	132.38 ± 100.74 s	29.73 ± 14.21 s	-102.65 s	<0.001

Table 3: Comparison of Pre- and Post-Intervention 10-Meter Walk Test (10MWT) Scores (seconds)

Group	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Mean Difference	p-value
Group A (Tele-Rehab)	152.92 ± 124.45 s	27.12 ± 15.25s	-126.12 s	<0.001
Group B (Conventional)	147.58 ± 106.20 s	38.85 ± 19.50 s	-108.73 s	<0.001

Discussion

The present study aimed to compare the effectiveness of task-oriented balance training delivered through telerehabilitation versus conventional clinical task-oriented balance training in stroke patients. The results demonstrated significant improvements in balance and functional mobility within both groups following five weeks of intervention. Crucially, no statistically significant difference was observed between the two groups across all outcome measures, indicating that telerehabilitation-delivered training is as effective as conventional clinical training.

The significant improvement in BBS scores in Group A (35.27 to 50.58; mean gain 15.31 points) and Group B (35.27 to 49.81; mean gain 14.54 points) indicates that task-oriented balance training effectively enhances postural control in stroke patients regardless of the mode of delivery. These findings are consistent with Chen et al. (2021), who reported equal or superior efficacy of a Kinect-based telerehabilitation system compared to conventional physiotherapy in individuals with chronic stroke [10]. Similarly, Lin et al. (2014) demonstrated comparable improvements in BBS scores between telerehabilitation and conventional groups in patients residing in long-term care facilities [11].

Significant improvements were also observed in TUG and 10MWT scores in both groups, reflecting enhanced dynamic balance, gait speed, and functional walking ability. The mean TUG improvement of 91.54 seconds in Group A and 102.65 seconds in Group B reflects clinically meaningful gains in functional mobility. These results are in agreement with Cikajlo et al. (2012), who reported similar improvements in postural function between telerehabilitation and conventional balance training groups in stroke patients [15]. Tchero et al. (2018), in a systematic review and meta-analysis, further concluded that telerehabilitation represents a suitable alternative to usual rehabilitation care in post-stroke patients, particularly in remote and underserved areas [16].

Task-oriented training promotes motor relearning through repetitive, goal-directed activities that engage neuroplastic mechanisms, facilitating functional recovery. The ability to deliver this training effectively via telerehabilitation may be attributed to the real-time supervisory capability of video conferencing platforms, which allow therapists to monitor, correct, and progress exercises remotely. Schroeder et al. (2019) supported this premise, noting that functional improvements through telerehabilitation-based balance training are equivalent to therapist-supervised in-clinic interventions [17].

The findings of this study have important implications for healthcare delivery, particularly in low- and middle-income countries such as India where stroke incidence has more than doubled over the past four decades and access to specialized rehabilitation remains limited [3]. Telerehabilitation eliminates the need for patient travel, reduces associated costs, and allows continuation of evidence-based rehabilitation in home settings. These advantages are especially relevant for elderly stroke patients with limited mobility or those residing in rural areas.

Study Limitations

The study employed convenience sampling and a relatively small sample size, which may limit generalizability. Telerehabilitation requires adequate technological literacy and operational training for patients, caregivers, and therapists. The cost of computer equipment and reliable internet connectivity may pose financial barriers, particularly for patients in long-term care facilities or low-income settings. Limited awareness and familiarity with telerehabilitation among patients may also influence acceptance and adherence. Future studies with larger

samples, longer follow-up periods, and randomized controlled designs are recommended.

Conclusion

The findings of the present study demonstrate that task-oriented balance training delivered through a tele-rehabilitation programme is comparable in effectiveness to conventional clinical task-oriented balance training in improving balance and functional mobility among stroke patients. Significant and clinically meaningful improvements were observed in Berg Balance Scale, Timed Up and Go, and 10-Meter Walk Test outcomes following five weeks of intervention in both groups, with no statistically significant difference between them. These results highlight the clinical relevance of tele-rehabilitation as a practical, accessible, and cost-effective approach to post-stroke balance rehabilitation, offering a viable alternative to in-clinic therapy while maintaining therapeutic effectiveness. Tele-rehabilitation holds particular promise for expanding rehabilitation access in rural and underserved populations where conventional clinical services may be limited.

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