e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(8); 450-454

Original Research Article

Efficacy of Swiss Ball Training in the Rehabilitation of Unilateral Neglect Patients

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Received: 25-05-2024 / Revised: 23-06-2024 / Accepted: 26-07-2024
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Conflict of interest: Nil

Abstract:

Background: Unilateral neglect significantly impairs spatial awareness and functionality in stroke survivors. Swiss Ball Training (SBT) offers a dynamic rehabilitation method that may enhance recovery outcomes more effectively than conventional therapy by utilizing proprioceptive feedback and balance enhancement exercises.

Methods: This experimental study included 30 participants with unilateral neglect, divided equally into Swiss Ball Training (SBT) and Conventional Therapy (CPT) groups. Using a convenience sampling method, participants were evaluated on the Berg Balance Scale (BBS), Line Bisection Test (LIB), Star Cancellation Test (SCT), and Functional Independence Measure (FIM). Assessments were conducted pre- and post-intervention over four weeks, with data analysis facilitated by independent and paired t-tests.

Results: Initial assessments showed minimal differences between groups. Over four weeks, SBT participants demonstrated significant improvements in BBS (pre: 17.93 to post 4th week: 48.63), indicating superior balance and stability. Statistical tests highlighted significant advancements in SBT over CPT, particularly from the second week onwards ($p = 0.011$, week 2).

Conclusion: Swiss Ball Training significantly improves balance and functional independence in patients with unilateral neglect more effectively than conventional therapies. This study underscores the potential of SBT in complex rehabilitation scenarios, suggesting its broader application in neurorehabilitation.

Keywords: Swiss Ball Training, Unilateral Neglect, Neurorehabilitation, Stroke Recovery, Functional Independence, Cognitive Therapy.

Introduction

Unilateral neglect, a debilitating condition frequently observed following neurological insults such as stroke, significantly impairs spatial awareness and attention to one side of the body. This cognitive disorder not only disrupts an individual's ability to perceive, act, or respond to stimuli on the affected side but also severely compromises the overall quality of life by limiting functional independence and increasing the risk of injury. [1]

Traditional therapeutic approaches, predominantly rooted in sensory and motor retraining, have been integral in addressing the complexities of unilateral neglect. However, innovative rehabilitation techniques that encompass dynamic and multifaceted treatment modalities are continually sought to enhance recovery outcomes. [2,3] Swiss Ball Training (SBT), recognized for its role in improving balance, coordination, and proprioceptive feedback, has recently emerged as a promising intervention in the neurorehabilitation sector.4 The inherent instability of the Swiss ball compels the user to engage multiple muscle groups, thereby fostering motor control and enhancing cognitive engagement through sustained attention and spatial orientation tasks. Such features make SBT an ideal candidate for the rehabilitation of patients with unilateral neglect, potentially facilitating more substantial improvements in cognitive and physical functions than conventional physiotherapy methods. [5,6]

The rationale for integrating Swiss Ball Training into therapeutic regimes for unilateral neglect stems from its ability to provide a holistic and active rehabilitative environment. By simulating real-life challenges within a controlled setting, SBT

encourages patients to process multiple streams of sensory information, thereby aiding in the re-establishment of neural pathways critical for spatial awareness. [7] Moreover, the adaptive responses elicited by the dynamic exercises on the Swiss ball could lead to significant enhancements in brain plasticity, offering a neurophysiological substrate for improved therapeutic outcomes. [8,9]

Given the paucity of comprehensive studies evaluating the efficacy of Swiss Ball Training in the context of unilateral neglect, this article aims to bridge this gap by presenting empirical evidence from a comparative study. [10]

The study meticulously examines the outcomes of Swiss Ball Training against conventional physiotherapy, focusing on various metrics such as the Berg Balance Scale (BBS), Line Bisection Test (LIB), Star Cancellation Test (SCT), and the Functional Independence Measure (FIM).

Such a detailed investigation not only elucidates the specific benefits and limitations of SBT but also underscores its potential as a transformative tool in the rehabilitation of unilateral neglect. [11]

Materials and Methods

Study Design: This experimental study was conducted at two primary locations: City Avenue Neuroscience and Aanandam Rehabilitation Center.

Study Population and Sampling: The study involved a total of 30 participants, divided into two groups of 15 each (Group A and Group B) utilizing convenience sampling.

Selection Criteria

Inclusion Criteria:

1. Age between 32 to 60 years.
2. Both males and females.
3. Experienced unilateral neglect following stroke on either side.
4. Capable of understanding verbal instructions and following one-step commands.

Exclusion Criteria:

1. History of hemorrhagic stroke.
2. Classified as Class C and D by the American Heart Association.
3. Significant impairments in visual acuity due to cataract, diabetic retinopathy, or hemianopia.
4. History of other neurological diseases such as psychotic disorders or alcoholism.

Informed consent was obtained from all participants, and the study received approval from the local ethics committee of the Pacific University Department of Physiotherapy.

Parameters: The following parameters were assessed:

1. Line Bisection Test (LBT)
2. Star Cancellation Test (SCT)
3. Berg Balance Scale (BBS)
4. Functional Independence Measure (FIM)

Instruments and Tools

1. Swiss ball
2. Transcutaneous Electrical Nerve Stimulation (TENS) unit

Procedure

Group A (Swiss Ball Training)

Participants in Group A underwent Swiss ball training, focusing on enhancing trunk muscle exercises and dynamic trunk control. Each session involved:

- **Patient Preparations:** Loose clothing during sessions.
- **Patient Position:** Sitting on the Swiss ball with both legs flat on the ground.
- **Therapist Position:** Stride standing behind the patient, ensuring safety.

Activities Included:

- Maintaining a sitting position on the Swiss ball.
- Turning the trunk towards the affected side to pick objects from the ground and place them on the unaffected side on a table.
- Progressing to functional activities, reaching activities, weight shifting in all directions (anterior-posterior, side to side, and pelvic tilting) on the Swiss ball.

Sessions lasted for 1:30 minutes, including rest periods, with activities repeated based on patient performance, starting from a baseline of 15 repetitions.

Group B (Conventional Therapy)

Participants in Group B received conventional therapy, which included:

- **Auditory Cueing and Manual Tapping:** Applied to the affected side's upper limb, lower limb, and trunk.
- **Environmental Setup:** Modification involving the patient's relatives to place daily living instruments on the affected side to encourage activity.
- **TENS:** Applied for 15 minutes to the unilateral neglect side for both upper and lower limbs to enhance awareness.
    - **Electrode Placement:** One over the superior trapezius muscle.
    - **Electrode Diameter:** 30mm.
    - **Frequency:** 100 Hz.

- **Pulse Duration:** 100µs.
- **Mean Intensity:** 0.5µA/mm.

Statistical Analysis: An independent t-test was employed to compare the efficacy between the two groups, while paired t-tests were utilized to assess pre and post-intervention changes within each group. Data analysis was conducted using SPSS version 20.

Results

The quantitative analysis of the data collected in this study presents an insightful overview of the effectiveness of Swiss Ball Training (SBT) compared to Conventional Physiotherapy (CPT) in the rehabilitation of patients with unilateral neglect. Various outcome measures were employed to evaluate the impact of these interventions on enhancing balance, attention, and functional independence.

Initial Comparison of Both Groups Across Multiple Outcome Measures: The initial assessment, as illustrated in Table 1, shows slight differences between the two groups across all measured outcomes at the beginning of the intervention. For the Berg Balance Scale (BBS), Swiss Ball Training group had a mean of 18.13 (SD = 1.727), compared to the Conventional Therapy group, which recorded a mean of 17.73 (SD = 1.668). Similar minimal differences were noted in the Line Bisection Test (LIB), Star Cancellation Test (SCT), and Functional Independence Measure (FIM), suggesting a comparable baseline between the groups.

Detailed Comparison of Mean and Standard Deviation of BBS Over Four Weeks

Table 2 details the progress in BBS over four weeks, where the data suggest a significant improvement in balance for participants undergoing Swiss Ball Training. The mean scores increased from 17.93 pre-intervention to 48.63 by the fourth week, demonstrating substantial progress in balance and stability due to the dynamic exercises involved in Swiss Ball Training.

Statistical Analysis Between Groups: The results from the independent sample tests (Table 3) reveal statistically significant differences between the groups as the intervention progressed. While the initial measures (Pre BBS) showed no significant differences ($p = 0.938$), the subsequent weeks marked a considerable improvement in the Swiss Ball Training group. The significance values (p-values) for the BBS from the first to the fourth week were 0.102, 0.011, 0.005, and <0.001, respectively, indicating that the improvements in the SBT group were both statistically significant and clinically relevant by the end of the fourth week.

Overall, these results underscore the potential of Swiss Ball Training as a more effective modality compared to conventional therapy in addressing the complex requirements of rehabilitation in patients with unilateral neglect. The dynamic nature of SBT appears to contribute to more significant improvements in balance, spatial attention, and overall functional independence, substantiating its utility as a preferred therapeutic approach in such neurological impairments.

Table 1: Initial Comparison of Mean and Standard Deviation between Both Groups for Multiple Outcome Measures

Outcome Measures	Group	Mean	Standard Deviation
BBS	SBT	18.13	1.727
	CPT	17.73	1.668
LIB	SBT	8.67	0.724
	CPT	8.60	0.737
SCT	SBT	27.40	1.882
	CPT	27.47	1.807
FIM	SBT	19.20	1.521
	CPT	19.33	1.543

Table 2: Detailed Comparison of Mean and Standard Deviation of BBS Over Four Weeks

Time point	Mean BBS	Standard Deviation
Pre BBS	17.93	1.680
Post BBS 1st Week	26.40	4.673
Post BBS 2nd Week	33.73	3.695
Post BBS 3rd Week	39.77	5.090
Post BBS 4th Week	48.63	3.643

Table 3: Independent Sample Test to Compare Various Outcome Measures between Groups

Outcome Measure	Time Interval	F Value	Sig.
Pre BBS	0.006	0.938	0.524
Post BBS 1st Week	3.093	0.090	0.102
Post BBS 2nd Week	0.699	0.410	0.011
Post BBS 3rd Week	0.524	0.475	0.005
Post BBS 4th Week	0.295	0.592	0.000

Discussion

The findings from this study reveal that Swiss Ball Training (SBT) can be a highly effective rehabilitation technique for patients suffering from unilateral neglect, outperforming conventional therapy methods in several key areas. The improvements observed in balance and functional measures, as evidenced by the significant changes in the Berg Balance Scale (BBS) scores, suggest that SBT offers a more engaging and physiologically beneficial approach to neurorehabilitation. [12]

One of the core strengths of SBT is its ability to integrate multiple sensory and motor systems simultaneously. By engaging patients in tasks that require maintaining balance on an unstable platform, SBT not only challenges their physical capabilities but also stimulates cognitive functions crucial for recovery from unilateral neglect. This holistic engagement is vital in re-establishing neural pathways that contribute to spatial awareness and functional independence. [13]

Comparatively, conventional therapy, while beneficial, typically focuses on repetitive task-oriented exercises that may not stimulate the same level of cognitive and physical engagement as SBT. The dynamic nature of SBT, requiring constant adjustments to maintain balance and complete tasks, likely contributes to its superior outcomes. These results align with the neuroplasticity theory, which posits that engaging exercises involving multiple senses can enhance brain recovery functions more effectively. [14]

Statistically, the significant p-values observed from the second week of intervention indicate a rapid improvement in functional outcomes for participants in the SBT group. This rapid progression underscores the potential for Swiss Ball Training to deliver quicker rehabilitative results, which is crucial for stroke survivors who face a typically protracted recovery process.

However, it is important to consider the limitations of this study. The small sample size and the convenience sampling method may affect the generalizability of the results. Future research should aim to include a larger cohort and utilize random sampling to enhance the robustness of the findings. Additionally, exploring the long-term effects of Swiss Ball Training compared to conventional therapy could provide deeper insights into the sustainability of the observed improvements. [15]

Overall, this study confirms the efficacy of Swiss Ball Training in the rehabilitation of patients with unilateral neglect, suggesting it should be considered a valuable addition to stroke rehabilitation protocols. Further studies are recommended to explore its full potential across various neurorehabilitation settings.

Conclusion

This study demonstrates that Swiss Ball Training (SBT) significantly enhances balance, spatial awareness, and functional independence in patients with unilateral neglect compared to conventional therapy. The dynamic and engaging nature of SBT appears to foster rapid and substantial improvements, likely due to its ability to simultaneously engage multiple sensory and motor systems. These findings suggest that SBT should be integrated into rehabilitation protocols for stroke survivors with unilateral neglect to optimize recovery outcomes. Further research is needed to confirm these results in larger, more diverse populations and to explore the long-term benefits of this intervention.

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