

Immediate Effects of Single-Leg Stance Exercise On Dynamic Balance and Weight Bearing in Traumatic Brain Injury Survivors: A Quasi-Experimental Study

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DOI: <https://doi.org/10.63363/aijfr.2026.v07i05.8515>

Abstract

Background: Traumatic brain injury (TBI) may lead to persistent balance difficulties, impaired postural control and reduced ability to transfer weight during functional activities. These problems can affect mobility and increase the risk of falls. Single-leg stance exercise is a simple task-specific activity that challenges balance and lower-limb control.

Objective: To investigate the immediate effects of single-leg stance exercise on dynamic balance and weight-bearing performance in TBI survivors.

Methods: This quasi-experimental pre-test/post-test study included 57 participants with a history of TBI recruited through multispecialty hospitals in Jalna, Maharashtra, using convenience sampling. Single-leg stance time and Step Test performance were assessed on the affected and unaffected sides before and after the intervention. Weight shifting and assistance required were also recorded. Since the outcome data were not normally distributed, pre- and post-intervention comparisons were performed using the Wilcoxon signed-rank test. Statistical significance was set at $p < 0.05$.

Results: Median single-leg stance time improved from 15 to 25 seconds on the affected side ($Z = -6.541$, $p < 0.001$) and from 19 to 29 seconds on the unaffected side ($Z = -6.185$, $p < 0.001$). Median Step Test scores increased from 15 to 25 on the affected side ($Z = -6.569$, $p < 0.001$) and from 22 to 30 on the unaffected side ($Z = -5.785$, $p < 0.001$). Poor weight shifting was recorded in all participants before intervention, while good weight shifting was recorded in all participants after intervention. The median assistance score decreased from 3 to 1 ($Z = -7.184$, $p < 0.001$).

Conclusion: The study found statistically significant immediate improvements in single-leg stance time, Step Test performance, observed weight shifting and assistance level following the single-leg stance intervention. Because the study used a quasi-experimental design without a reported control group and assessed immediate outcomes, the findings should be interpreted cautiously.

Keywords: Traumatic brain injury; single-leg stance; dynamic balance; weight bearing; Step Test; physiotherapy.

1. Introduction

Traumatic brain injury is caused by an external force that disrupts normal brain function. Depending on the site and severity of injury, survivors may experience motor, sensory, cognitive and behavioural difficulties. Balance impairment is an important rehabilitation concern because it can interfere with standing, walking, turning and other daily activities. Changes in postural control may also affect the person's confidence and independence.

Balance depends on the integration of visual, vestibular and somatosensory information with appropriate motor responses. Following TBI, disruption of these systems may contribute to postural instability, impaired weight shifting and difficulty controlling the body during movement. Research reviews have described balance deficits after TBI and the use of different physiotherapy approaches to address them [2–5].

Single-leg stance requires a person to maintain the body over a narrow base of support while controlling trunk and lower-limb movements. The task can be used in clinical assessment and adapted as a balance exercise, provided that appropriate guarding and safety measures are used. The Step Test challenges stepping ability and dynamic postural control. However, the immediate response to a single-leg stance intervention in TBI survivors requires further study.

Therefore, this study investigated changes in single-leg stance time, Step Test performance, observed weight shifting and assistance requirements immediately before and after single-leg stance exercise in individuals with TBI.

2. Aim and Objectives

Aim: To investigate the immediate effects of single-leg stance exercise on dynamic balance and weight-bearing performance in TBI survivors.

Objectives:

1. To compare single-leg stance time on the affected and unaffected sides before and after intervention.
2. To compare Step Test scores on the affected and unaffected sides before and after intervention.
3. To describe changes in observed weight shifting and assistance required.

3. Materials and Methods

3.1 Study design and setting

A quasi-experimental pre-test/post-test study was conducted using participants recruited through multispecialty hospitals in Jalna, Maharashtra, India. The study duration was reported as six months.

3.2 Participants and sampling

A total of 57 participants with a history of traumatic brain injury were included through convenience sampling. The thesis reports an age range of 18–45 years in the study population and demographic results; its inclusion criteria separately state 18–45 years. This age-range inconsistency should be checked and resolved by the authors before submission.

3.3 Eligibility criteria

The thesis lists TBI associated with road traffic accidents or falls involving a head injury as inclusion criteria and describes participants at Brunnstrom recovery stage 4. Exclusion criteria include a history of other neurological conditions, including stroke or multiple sclerosis, and pre-existing neurological disorders. The exact eligibility criteria should be verified against the approved study protocol.

3.4 Outcome measures

Single-Leg Stance Time Test: Participants were asked to stand on one leg while lifting the opposite foot. The examiner guarded the participant for safety and recorded the time maintained, up to a maximum of 30 seconds hold for 5 repetitions and if the patient balance is out. The test was performed on both sides.

Step Test: Participants repeatedly stepped onto and off a step using the test leg during the specified testing period. The examiner observed performance and recorded the number of correctly completed steps. The test was performed on both sides.

Additional observations: Weight shifting was recorded as poor or good. Assistance required was coded as none (0), minimum (1), moderate (2) or maximum (3), as reported in the thesis.

3.5 Procedure

The test procedures were explained to participants and consent was obtained according to the thesis. Baseline measures were recorded for both legs. Participants then completed the single-leg stance exercise intervention, after which the outcome measures were repeated. The source document does not clearly specify the exact exercise dosage, number of repetitions, rest intervals or total duration of the intervention session. These details should be inserted from the original protocol before journal submission; they should not be guessed.

3.6 Statistical analysis

The Shapiro–Wilk test was used to assess normality. As the continuous outcome variables were reported as non-normally distributed, pre- and post-intervention comparisons were analysed using the Wilcoxon signed-rank test. A p-value below 0.05 was considered statistically significant.

4. Results

Fifty-seven participants were included. The thesis reports a mean age of 31.89 ± 6.64 years, mean BMI of 21.98 ± 2.01 kg/m² and mean time since injury of 41.58 ± 34.01 days. There were 40 male participants (70.2%) and 17 female participants (29.8%). The right side was reported as affected in 40 participants (70.2%).

Outcome	Pre-intervention median	Post-intervention median	Z value	p-value
SLS time – affected side (seconds)	15	25	–6.541	<0.001
SLS time – unaffected side (seconds)	19	29	–6.185	<0.001
Step Test – affected side	15	25	–6.569	<0.001

Step Test – unaffected side	22	30	–5.785	<0.001
Assistance required (coded score)	3	1	–7.184	<0.001

Single-leg stance time increased significantly on both sides. The affected-side median increased from 15 to 25 seconds, and the unaffected-side median increased from 19 to 29 seconds. Step Test scores also increased significantly on both sides. The affected-side median increased from 15 to 25, while the unaffected-side median increased from 22 to 30.

For weight shifting, all 57 participants were classified as having poor weight shifting before intervention and all 57 were classified as having good weight shifting after intervention. The thesis notes that a McNemar–Bowker test was not computed because there was no variation in the pre- and post-intervention categories. Assistance required decreased significantly, with the median coded score falling from 3 to 1.

5. Discussion

The findings indicate statistically significant immediate changes in all reported continuous outcome measures after the single-leg stance intervention. The increase in single-leg stance time suggests that participants were able to maintain single-limb support for longer during post-intervention testing. The improvement occurred on both the affected and unaffected sides, although the affected side began with a lower median value.

The Step Test scores also increased on both sides. Stepping requires controlled weight transfer, foot placement and postural adjustments, making it relevant to functional mobility. The observed improvement may indicate better task performance immediately after the exercise session. However, because there was no control group reported in the thesis, it is not possible to determine with certainty whether all changes were caused by the intervention rather than practice effects, repeated testing, attention or other factors.

The recorded shift from poor to good weight shifting in all participants and the reduction in assistance scores are notable descriptive findings. These results should be interpreted carefully because weight shifting was measured categorically, and the thesis reports that a paired categorical test could not be computed for the weight-shifting categories. In addition, the assistance scale is ordinal; its coding and scoring method should be clearly described in the final manuscript.

The findings are broadly relevant to literature describing balance difficulties after TBI and the role of rehabilitation in addressing balance and mobility limitations [2–5]. Nevertheless, the present study evaluates immediate pre- and post-intervention change only. It does not establish whether improvements persist, transfer to walking or daily activities, or reduce falls. Future studies should use a clearly standardised exercise protocol, a control or comparison group, validated outcome measures and follow-up assessments.

6. Limitations

The study used convenience sampling and a quasi-experimental pre-test/post-test design. A control group was not reported. Outcomes were assessed immediately after the intervention, so the duration of any improvement is unknown. The source thesis does not clearly report the exact exercise dosage, and it

contains an inconsistency in the stated age eligibility range. Weight shifting was assessed categorically, and further information about its operational scoring is needed. These issues should be addressed transparently before submission.

7. Conclusion

In this sample of 57 TBI survivors, single-leg stance exercise was followed by statistically significant immediate improvements in single-leg stance time and Step Test scores on both the affected and unaffected sides. The thesis also recorded improved weight-shifting categories and reduced assistance requirements after intervention. These findings suggest that single-leg stance activity may be a useful component of supervised balance rehabilitation; however, controlled studies with a clearly specified protocol and follow-up are needed before drawing conclusions about causality or lasting functional benefit.

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