Effect of Lumbar Stabilization Exercises on the Balance Ability of Patients with Stroke: A Systematic Review

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Abstract. [Purpose] This study performed a systematic literature review of the ability of lumbar stabilization exercises (LSE) to improve the balance ability of stroke patients. [Subjects and Methods] A systematic review was conducted of four databases. The papers retrieved were evaluated based on the following inclusion criteria: 1) design, a controlled clinical trial; 2) intervention, LSE; 3) outcome, change in balance ability; and 4) year of publication, 2000 to 2013. [Results] The findings of 6 papers were compared to determine the effects of lumbar stabilization exercises on stroke patients’ balance abilities. The papers had methodological quality scores of 5–8 on the PEDro scale. [Conclusion] Lumbar stabilization exercises have a positive influence on stroke patients’ balance abilities. Key words: Balance ability, Lumbar stabilization exercise, Stroke

INTRODUCTION

Balance is indispensable to an individual’s ability to safely and independently perform activities of daily living such as moving or walking3). In stroke patients, trunk muscle weakness and the loss of proprioception on the affected side can interfere with balance, stability, and functional ability2, 3) and may reduce the ability to control posture4). However, the balance abilities of stroke patients are also impaired by perceptual problems, proprioceptive sensory system abnormalities, and paralysis of the limbs and trunk muscles5, 6). Therefore, strengthening the trunk muscles is crucial for improving stroke patients’ balance abilities and physical performance7).

Lumbar stabilization exercises are used as a standard therapy for low back pain because they help improve postural alignment and balance ability by simultaneously activating the transversus abdominis and multifidus muscles. These muscles controlled by the central nervous system from the cerebral hemispheres, and their improvement leads to the recovery of normal gait and movement patterns8).

Heish et al.7) stressed the importance of trunk control assessment and treatment as an early predictive factor of general activities of daily living performance of stroke patients. Feigin et al.9) pointed out that trunk stabilization in stroke patients is an important prognosticator of the recovery of balance ability and functional ambulation.

Systematic reviews are used to eliminate bias and to facilitate more objective analysis of results, in order to arrive at definitive conclusions about certain interventions10).

This study aimed to perform a systematic literature review to determine the effects of lumbar stabilization exercises on the balance abilities of stroke patients.

SUBJECTS AND METHODS

Searches were carried out of the PubMed databases using the key words of: lumbar stabilization, core stabilization, stroke, hemiplegia, and balance.

The papers retrieved were evaluated by two blinded researchers employing the following inclusion criteria: 1) design, controlled clinical trial; 2) intervention, LSE; 3) outcome, change in balance ability; and 4) year of publication, 2000 to 2013.

The selected papers were analyzed for methodological quality using the PEDro scale. This scale has 11 items for the assessment of internal validity and statistical information in randomized, controlled trials. Each adequately met item contributes one point to the maximal score of 10 points except Item 1, which is related to external validity. The official score of the papers described in the electronic database was used. For cases in which the manuscript was not found in the PubMed database, the evaluation was performed independently by two blinded researchers. A third researcher performed the evaluation when divergences occurred in the evaluations of the first two researchers.
RESULTS

To investigate the ability of lumbar stabilization exercises to enhance stroke patients’ balance abilities, 6 papers were collected from PubMed. All 6 papers had a minimum of 5 points on the PEDro scale, and they were considered methodologically adequate (Table 1).

The 6 studies involved a total of 168 subjects. Each study had subject groups (8 ≤ N ≤ 16) of various types of patients with acute or chronic stroke. Men outnumbered women and the most common age groups were 50–59 years and 60–69 years (Table 2).

With regard to the intervention method, most studies opted for a controlled study design with an experimental group receiving lumbar stabilization exercise intervention and a control group receiving conventional physiotherapy or general exercise intervention. The most common intervention session duration was 30 minutes.

The balance ability assessment tools included the trunk impairment TIS, functional reach test (FRT), Tinetti test, Romberg eyes open (REO), Romberg eyes closed (REC), four test balance scale (FTBS), Berg balance scale (BBS), static sitting balance (SSB), dynamic sitting balance (DSB), and Brunel balance assessment (BBA) (Table 3).

Comparison of the lumbar stabilization exercise group (LSE group) and conventional physiotherapy group (CPT group) of patients with acute stroke revealed that the former showed significant improvements in the DSB, FTBS, and BBS assessments. In one study that compared the lumbar stabilization exercise outcomes of the experimental and control groups on unstable and stable bases of support the experimental group showed significant improvements in the BBA and DSB assessments (Table 3).

Comparison of the LSE and CPT groups of patients with chronic stroke revealed that the LSE group showed significant improvements in the FRT and TUG assessments. Comparison of the lumbar stabilization exercise outcomes on unstable (experimental group) and on stable (control group) bases of support showed significant improvements without any intergroup differences (Table 3).

DISCUSSION

In this study, a systematic review of the literature was performed regarding the effects of lumbar stabilization exercises on stroke patients’ balance abilities, to identify the characteristics of the trial subjects and to determine the effects of lumbar stabilization exercises on the balance ability of stroke patients compared to the traditional physiotherapy intervention.
To maintain normal postural balance, the information delivered by the afferent neurons of the somatosensory, visual, and vestibular systems need to be integrated and controlled in the brainstem, and the reflex movements of the limbs need to be controlled\(^{17}\). However, stroke patients have difficulty maintaining their balance and motor performance as a result of reduced postural control and balance abilities arising from decreased orientation and equilibrium reactions attributable to impaired coordination of the control centers in the brainstem induced by upper motor neuron lesions\(^{18,19}\).

Thus, the post-stroke recovery of balance ability and postural control relies on training with exercises that enhance such abilities.

The conventional physiotherapy treatments conducted for stroke patients have considerable drawbacks, e.g. high cost, human resource and time requirements, and long duration\(^{20,21}\). Lumbar stabilization exercises are assumed to have contributed in DST\(^{12-14}\). In a sitting position, subacute stroke patients maintained their anteroposterior balance using their lower extremities and rely exclusively on trunk control for mediolateral balance\(^{22}\). As such, the DST improvement is presumably attributable to enhanced trunk stability due to the muscle strength being enhanced by lumbar stabilization exercises which helped to maintain the center of gravity within the basal support area of the body.

With regard to patients with chronic stroke, 2 studies compared the outcomes of the lumbar stabilization exercise on unstable (experimental group) and stable (control group) bases of support. They found that the experimental groups showed significant improvements in FRT and TUG\(^{11,15,16}\). In a standing position, postural balance is essential for transferring the body weight from one lower extremity to the other, as well as in daily activities involving standing up, walking, and changing directions\(^{23,24}\). Given that patients with chronic stroke, living in a state of long-term reduced muscle activities, have remarkably poorer trunk control ability than normal people because of postural balance deficits\(^{25}\), lumbar stabilization exercises are assumed to have contributed to the enhancement of FRT and TUG through improvement of the lumbar-pelvic-hip complex, leading to improved postural alignment and balance.

Despite stroke patients lacking trunk control ability, the subjects of many studies of lumbar stabilization exercises were limited to patients with lower back pain. In this study, it was confirmed through a systematic literature review that lumbar stabilization exercises effectively improve the balance abilities of both acute and chronic stroke patients. Hence, future research is expected to focus on training and studies conducted on lumbar stabilization exercises for patients with stroke.

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**Table 3. Methods and result of the papers included in this review**

| Paper | Intervention | Assessment | Result/outcome |
|-------|--------------|------------|----------------|
| 1     | TSE (EG) vs. general therapeutic exercise (CG) | FRT | The change of FRT score in the EG was significantly higher than that of the CG. |
| 2     | Truncal exercise + CPT (EG) vs. arm therapy + CPT (CG) | DSB, Tinetti test, REO, REC, FTBS, BBS | The changes of Tinetti test, DSB, FTBS, and BBS scores in the EG were significantly higher than those of the CG. |
| 3     | Trunk exercise + CPT (EG) vs. CPT (CG) | Tinetti test, SSB, DSB | The change of DSB score in the EG was significantly higher than that of the CG. |
| 4     | + CPT (CG) | SSB, DSB, BBA | The changes of DSB and BBA scores in the EG were significantly higher than those of the CG. |
| 5     | TSE (unstable surface) vs. TSE (stable surface) | SP, SA, SAP | In terms of changes in balance ability, the sway path (SP) significantly improved in the stable group, and the SP, sway area (SA), and TIS significantly improved in the unstable group. |
| 6     | TSE (EG) vs. general training program (CG) | TUG | The EG showed significant improvements in TUG. |

TSE: trunk stability exercise; CPT: conventional physical therapy; EG: experimental group; CG: control group; FRT: functional reach test; DSB: dynamic sitting balance; REO: Romberg eyes open; REC: Romberg eyes closed; FTBS: four test balance scale; BBS: Berg balance scale; SSB: static sitting balance; BBA: Brunel balance assessment; TUG: timed up and go test
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