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Case Study

Effects of modified bridging exercises on static postural control of a poststroke hemiplegic patient who had received surgery for lumbar spinal stenosis: a case report

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Abstract. [Purpose] This study investigated the efficacy on postural control of a bridging exercise in order to suggest a pertinent procedure for the bridging exercise. [Subject] One poststroke hemiplegic patient who had received surgery for lumbar spinal stenosis participated in this study [Methods] A reverse ABAB single-case experimental design was used. To assess postural control, foot pressure and the stability limit test were evalulated once a week a total of 4 times during the intervention period. [Results] Noticeable improvement in the distribution of foot pressure and increased stability limit were shown after performing the bridging exercise supervised by a physical therapist. [Conclusion] Bridging exercise on a plinth is effective at balancing body weight-bearing and resulted in the patient putting her weight on both feet evenly and in both the anterior and posterior directions.
Key words: Bridging exercise, Hemiplegia, Postural control

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INTRODUCTION

Bridging exercises (BE) are commonly used therapeutically for lumbopelvic stabilization[1)]. Doing BE on a plinth lowers the center of gravity of the patient, which reduces fear and the instability of weight-bearing during gait, and allows exercise in a secure posture on the plinth[2)]. BE help to coordinate global and local muscle development[1)]. Lumbar spinal stenosis induces postural abnormalities like wide-based gait, which hampers the opportunity to use an ankle strategy to control balance in activities of daily living[3)], and forward bending is a way of reducing leg pain and cramp when standing[4)]. Balance is diminished in people with hemiplegia[5)], and hemiplegia can cause a reduction in patients' limits of stability, which is defined as the maximal distance that an individual can shift his or her weight in any direction without loss of balance[6)]. The purpose of this study was to verify the effects of a modified bridging exercise on the static balance of a stroke patient with lumbar spinal stenosis. Improvements in center of foot pressure displacement and symmetry of feet pressure without stepping indicate that the exercise improved the patient's postural control.

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SUBJECTS AND METHODS

The subject was a 64-year-old woman hospitalized in D hospital, Daejon, South Korea. She had right hemiplegia with cerebral infarction in the pons. The time lapsed since the onset of stroke was 19 months. Other medical history included diabetes mellitus (DM), hypertension (HTN), appendectomy and lumbar spinal stenosis (LSS) of L4 and L5. Since recieving surgery for LSS on 25 February, 1998, the patient had used an orthosis to secure stability around the surgical area for about 3 months. After surgery she was not able to make natural movement of the pelvis. She had been taking medication for DM and HTN for about 25 years. Her mother had HTN and her older sister died from a stroke many years ago. The subject provided her written informed consent to take part in the study prior to its commencement, and this study conformed to the principles of the Declaration of Helsinki. The patient's mobility status was 27 points on the Berg balance scale (BBS). She performed bridging exercises (BE) for 2 weeks every other week from June 2 to 27, 2014. A BioRescue (AP 1153, France)[7)] was used as the assessment tool. For the bridging exercise, the patient lay in the supine position on a plinth with lines marked on it to indicate where the parts of the body should be located. There were three lines: an upper line for the position of the first lumbar vertebra, a middle line for the position of the anterior superior iliac spine, a lower line for the position of the feet at which the knee joints were flexed at 60 degrees[1)]. After positioning the body parts correctly on the lines, a physical therapist put both his hands on both of the patient's greater trochanters, then palpated the rectus femoris, tensor fascia latae and hamstring muscles. Before raising the pelvis,

the patient was instructed to draw the umbilicus in and up toward the spine with no movement of pelvis and trunk to facilitate activation of the transverse abdominis[8]. Then, she lifted the pelvis for 2 seconds up to first lumbar vertebral region, maintained the bridge position for 5 seconds, and lowered the pelvis back for 2 seconds[1]. The time was measured by a stopwatch. The patient repeated the procedure 18 times for one set, and there was 1-minute rest between each set. She performed 6 sets in 30 minutes of one treatment day, and the treatment continued for 5 days. Feet Pressure (FP) measured by baropodometric image and stability limit (SL) were measured at the end of each week for 4 weeks. The tests consisted of baseline 1 (B1, A condition) which was conducted before practicing BE with the physical therapist who had 8 years of clinical experience, treatment 1 (T1, B condition) after practicing BE for 5 days, baseline 2 (B2, A condition) at the end of the 3rd week in which no exercise was performed, and treatment 2 (T2, B condition) after BE for 5 days.

RESULTS

In the outcomes of foot pressure, after the first intervention, the ratio of the distribution of the feet pressure deviated to the left side (52.1±1.1%) which was the less affected side. Afterward, the ratio of the foot pressure gradually moved to the affected side (48.9±3.6%), and eventually the subject was able to transfer more of her weight onto the right foot (56.4±1.9%) in the final assessment. The forward distance at B1 was 0.30 cm, and after the first intervention the forward distance (2.40 cm) at T1 was longer than before. Even though the final result of the forward distance was 0.90 cm: which is smaller than T1 and B2 (3.50 cm), the forward distance continued to increase 0.6 cm over that of B1. In addition, backward distance increased as the intervention continued. The difference of the results between B1 (0.80 cm) and T2 (3.10 cm) is 2.30 cm, which is longer than the result of B1.

DISCUSSION

Stroke patients, who are at a relatively early stage post-onset, show a marked deficit in weight-shifting to the affected leg[9]. Flexibility of the hip joint is necessary for gait without pain in patients with LSS[10]. In this case report, the patient succeeded in transferring her body weight to the affected side (56.4%) at the end of the experiment. This was achieved because the purpose of BE is to facilitate the proximal hamstring muscle so that the pelvis can be more posteriorly tilted. Moreover, the subject gained experience of having the affected foot on the ground more actively through the repetitive practice of BE. As a result the subject was better able to move her body weight to the affected side in standing. In a previous study of subjects with hemiparesis, the dynamic measures of stability (sway path, sway error) were found to be more reliable than static measures[11]. In this case report, stability limit is similar to the dynamic measures mentioned above. Many patients have difficulty in forward and backward body movement. Because subjects with hemiplegia after stroke normally use a hip strategy instead of an ankle strategy due to changes in the ground reaction force and increased muscle tone of the hip flexors. Subjects feel they would fall down when moving a little bit forward or backward. So, regaining the ability to move forward and backward is very important for maintaining posture in standing as well as walking. Therefore, in the final assessment, the increases in the subject's anterior and posterior stability limits were meaningful, indicating that she had gained more efficient postural control.

REFERENCES

1) Stevens VK, Bouche KG, Mahieu NN, et al.: Trunk muscle activity in healthy subjects during bridging stabilization exercises. BMC Musculoskelet Disord, 2006, 7: 75–82. [Medline] [CrossRef]
2) Schunk MC: Electromyographic study of the peroneus longus muscle during bridging activities. Phys Ther, 1982, 62: 970–975. [Medline]
3) Watters WC 3rd, Baisden J, Gilbert TJ, et al. North American Spine Society: Degenerative lumbar spinal stenosis: an evidence-based clinical guideline for the diagnosis and treatment of degenerative lumbar spinal stenosis. Spine J, 2008, 8: 305–310. [Medline] [CrossRef]
4) Sasaki K, Senda M, Katayama Y, et al.: Muscle strength during active straight leg raising correlate with walking capacity in patients with lumbar spinal canal stenosis with neurogenic intermittent claudication. J Phys Ther Sci, 2011, 23: 625–627. [CrossRef]
5) Liston RA, Brouwer BJ: Reliability and validity of measures obtained from stroke patients using the Balance Master. Arch Phys Med Rehabil, 1996, 77: 425–430. [Medline] [CrossRef]
6) Geiger RA, Allen JB, O'Keefe J, et al.: Balance and mobility following stroke: effects of physical therapy interventions with and without biofeedback/forceplate training. Phys Ther, 2001, 81: 995–1005. [Medline]
7) http://www.rmingenierie.net/stabilite-posture.
8) Drysdale CL, Earl JE, Hertel J: Surface electromyographic activity of the abdominal muscles during pelvic-tilt and abdominal-hollowing exercises. J Athl Train, 2004, 39: 32–36. [Medline]
9) Goldie PA, Matyas TA, Evans OM, et al.: Maximum voluntary weight-bearing by the affected and unaffected legs in standing following stroke. Clin Biomech (Bristol, Avon), 1996, 11: 333–342. [Medline] [CrossRef]
10) Kim ER, Kang MH, Kim YG, et al.: Effects of a home exercise program on the self-report disability index and gait parameters in patients with lumbar spinal stenosis. J Phys Ther Sci, 2014, 26: 305–307. [Medline] [CrossRef]
11) Nichols DS: Balance retraining after stroke using force platform biofeedback. Phys Ther, 1997, 77: 553–558. [Medline]