

The effects of trunk stability exercise and a combined exercise program on pain, flexibility, and static balance in chronic low back pain patients

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Abstract. [Purpose] The aim of this study was to examine the effect of trunk stability exercise and combined exercise program on pain, flexibility, and static balance in chronic low back pain patients. [Subjects and Methods] Thirty persons diagnosed with chronic low back pain were divided into a trunk stability exercise group and a combined exercise group and then conducted exercise for six weeks. [Results] VAS and sway lengths decreased significantly in both groups. A comparison of sway lengths after the intervention between the two groups revealed that the trunk stability exercise group had a bigger decrease than the combined exercise group. [Conclusion] The results of this study indicated that trunk stability exercise would have bigger effect than combined exercise on the daily activities of chronic low back pain patients as it strengthens deep abdominal muscles and improves flexibility and balancing ability.

Key words: Low back pain, Balance, Trunk stability exercise

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INTRODUCTION

Low back pain is classified as acute if the duration of pain is less than 6 weeks, subacute if the duration is between 6 weeks and 12 weeks, and chronic if the duration is over 12 weeks. Most low back pain lasts for 2 to 3 months. However, recurrence is very common¹⁾. Even though most recurrences can be treated, 5 to 15% cannot be treated, and the patients continue to experience pain²⁾. There are various causes of low back pain. The most common causes are the low back structure, biomechanical factors and regressive changes in surrounding tissues, psychological factors, various types of infections, metastatic osteosarcoma, and congenital spinal abnormality³⁾.

In addition, low back pain causes changes in low back structure and surrounding tissues. As a result, the abdominal muscles, which are related to the stability of the trunk, are weakened, and this causes pain and functional limitations⁴⁾. When low back pain gets worse, it limits physical activities. When it becomes chronic, the cross section of the muscles surrounding the spine decreases and causes disuse muscle atrophy⁵⁾. Among the various causes of low back pain,

Panjabi reports⁶⁾ that instability of the spine is the most important cause among biomechanical causes. He mentions that instability of the lumbar vertebrae is recognized as a very serious factor by chronic low back pain patients⁷⁾. It causes pain, reduces endurance and flexibility, and limits the range of motion of the waist⁸⁾.

Panjabi reports that dynamic trunk stability exercise, a muscle strengthening exercise for the local muscle group located in the trunk core around the lumbar vertebrae that plays an important role in providing dynamic stability to spinal segments, is useful for reducing functional disability of the spine. If the muscles lack stability, they make inaccurate movements^{9, 10)}.

Balance control requires well-controlled voluntary movement and reflective muscle reaction¹¹⁾. Generally, the body core is stabilized by actively controlling physical stability and tension against gravity, bearing surface, vision, and exterior environment through interaction between various sensory nerves¹²⁾. In many studies, special exercises including trunk stability exercise have been reported to be more effective^{13, 14)} and complex exercises including aerobic exercises and resistance exercises have been reported to have a positive effect on body composition, bone density, and development neuromuscular development¹⁵⁾.

Although trunk stability exercise and resistance exercise are known to be effective in stabilizing the spine, there are not enough studies on standardized exercise therapies with combined exercise and their effect. Therefore, this study investigated the effect of trunk stability exercise and a combined exercise program on pain, flexibility, and static

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balance in chronic low back pain patients.

SUBJECTS AND METHODS

This study chose 30 adults between the ages of 30 and 40 who had been diagnosed with chronic low back pain from the members of U-Sport Center, Gyeongsan-si, Gyeongsangbuk-do, Republic of Korea. They were divided into a trunk stability exercise group and a combined exercise group and exercised 3 times a week for 6 weeks.

The study subjects met the following conditions; 1) no cardiovascular or orthopedic diseases, 2) no neurological diseases, 3) no loss of balance ability caused by vestibular damage or vision damage, 4) no use of medication for low back pain, 5) no experience with exercise similar to that in this experiment, and 6) chronic low back pain that does not prevent performance of daily activities. All the subjects understood the purpose of this study and provided their written informed consent prior to participation in the study in accordance with the ethical standards of the Declaration of Helsinki (Table 1).

The trunk stability exercise program was conducted 3 times a week for 6 weeks. The exercise program included a ; warm-up (10 minutes: stretching), the main exercise (40 minutes: bridge exercise, crunch exercise), and a cooldown (10 minutes: stretching). The combined exercise program was also conducted 3 times a week for 6 weeks. The exercise program included a; warm-up (10 minutes: stretching), the main exercise (40 minutes: muscle resistance exercise, fast walking exercise), and a cooldown (10 minutes: stretching). Pre and post-treatment pain intensity were measured by using a visual analogue scale (VAS). For balancing ability, this study used a BioRescue (RM Ingénierie, Rodez, France) and measured sway length and sway area from the center of gravity of the body. All the results of measurement are expressed as the mean± standard deviation.

PASW Statistics for Windows (version 18.0) was used for data analyses. The paired t-test was used to analyze the difference between before and after the intervention. The independent t-test was used to determine the differences in the results of each group. The statistical significance level was $\alpha = 0.05$.

RESULTS

After the intervention, the VAS scores of both the groups decreased significantly ($p < 0.05$). Sway length and sway area also decreased significantly ($p < 0.05$). When we compared the two groups after the intervention, the trunk stability exercise group had a bigger decrease in sway length compared with the combined exercise group ($p < 0.05$) (Table 2).

DISCUSSION

This study applied a trunk stability exercise program and a combined exercise program to the study subjects, who had been diagnosed with chronic low back pain. Sway area and sway length were measured to determine balance ability, and a VAS was used to measure the level of pain to see the effect of the exercises on pain. Since low back pain patients

Table 1. General characteristics of subjects

	TSE	CE
Gender (M/F)	8/7	9/6
Age (years)	34.5±4.0	34.0±2.9
Height (cm)	171.3±5.3	175.0±4.4
Weight (kg)	62.6±4.6	75.0±11.6

Mean±SD. TSE: trunk stability exercise; CE: combined exercise

Table 2. Comparison of measurement values before and after the intervention

Variable	Group	Pre	Post
VAS (score)	TSE	4.8±1.1	1.6±0.6 ^a
	CE	5.2±0.1	2.1±8.9 ^a
Step length (mm)	TSE	82.1±10.9	52.5±11.1 ^a
	CE	78.8±16.6	69.6±15.2 ^a
Sway area (mm ²)	TSE	144.8±37.2	107.6±20.8 ^{ab}
	CE	151.5±37.5	109.3±25.8 ^{ab}

^aSignificant difference between pre- and post-intervention values, ^bSignificant difference in post-intervention values between the TSE and CE groups

have reduced static balance abilities compared with normal people, which causes decreased postural stability¹⁶), it is necessary to reduce the shearing force applied to the low back through exercises that improve trunk stability so that the patients can acquire stability pelvis and trunk.

This study applied a trunk stability exercise program and combined exercise program to subjects who were diagnosed with chronic low back pain to determine the levels of trunk stability acquisition. The sway area and sway length were measured. The two groups showed a significant decrease, which is a positive result. Trunk stability exercise is an exercise which improves the balance and stability of the body. It allows simultaneous activation of abdominal muscles and multifidus, the fine motor muscle of the spine¹⁷). The muscles in this part of body are tension and postural muscles, and they play an important role in trunk stability and posture control when and individual performs whole body exercise. They also counteract the imbalance of muscles necessary for maintaining posture¹⁸). When we measured the VAS after the two groups performed the trunk stability exercise and combined exercise, both groups showed a significant decrease in pain. It is assumed that the two exercise programs improved trunk stability and strengthened muscle significantly, and resulted in reduced pain due to activation of trunk muscles.

According to the results of this study, chronic low back pain patients can reduce their pain significantly if they regularly and continuously exercise as shown in our results, even with different types of exercise as in this study. Considering the matter of effectiveness, trunk stability exercise would have bigger effect on a chronic low back pain patient's daily activities, as it strengthens deep abdominal muscles and improves flexibility and balance ability. There are some limitations to this study. First of all, it did not have enough

subjects. In addition, only a limited number of evaluations were performed, so it was not possible to verify the effect of the exercises on the chronic low back pain patients. Moreover, it was not possible to determine whether the subjects continued performing the trunk stability exercise or combined exercise. Future studies should conduct a follow-up test to understand how subjects maintain exercise programs so that the results can be well-used by many chronic low back pain patients who suffer from restrictions due to back pain and by many therapists who are responsible for therapeutic exercise.

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