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Effect of Core Stabilization Exercise on Cobb's Angle and Balance of Scoliosis Patients

Sang Woong Park[1], Junghyun Kwon[2], Yeong Cheol Heo[3], Wonjong Yu[4]*
[1]*Professor, Department of Emergency Medical Services, Eulji University, South Korea*
[2]*Master's Degree, Department of Physical Therapy, Eulji University, South Korea*
[3]*Professor, Department of Radiological Science, Eulji University, South Korea*
[*4]*Professor, Department of Physical Therapy, Eulji University, South Korea*
swpark@eulji.ac.kr[1], lael170222@gmail.com[2], eehrrn@hanmail.net[3], wjyu@eulji.ac.kr[4]*
Corresponding author: Wonjong Yu, E-mail : wjyu@eulji.ac.kr*

Abstract

Background/Objectives: Scoliosis is a disease in which the spine is curved sideways. This is treated through surgery and the effect of physical treatment is still unclear. Hence, this study was conducted to investigate the effect of core stabilization exercise on the balance ability of scoliosis patients.

Methods/Statistical analysis: We studied 33 women who were ≥20 years of age and diagnosed with scoliosis. Subjects who participated in the experiment were divided into two groups via random selection: 17 under the experimental group and 16 under the control group. Both groups received general physical therapy. The experimental group performed core stabilization exercises 50 minutes per day for three times a week (24 times for 8 weeks in total), while the control group performed manual massage for the same period. Cobb's angle was measured, and 3D-Centour was used to investigate changes in dynamic balance and static balance. The experimental and control groups were compared before and after the experiment. Afterwards, frequency analysis, independent t-test, and paired t-test were performed using SPSS (window version 20).

Findings: There was a significant difference in the core stabilization exercise group after the intervention of each group ($p<.01$), during the intervention pre-post balance ability ($p<.01$), and between the control and balance ability ($p<.01$).

Improvements/Applications: Results showed that core stabilization exercises helped to change Cobb's angle and improve balance ability in scoliosis patients.

***Keywords*:** *Core Stabilization Exercise, Scoliosis, Static balance, Dynamic balance, Cobb's angle*

1. Introduction

In scoliosis, the spine is bent or deflected laterally along the central axis, resulting to rotational deformation of the vertebrae [1]. This is a three-dimensional malformation that occurs when the normal curvature disappears. It is not only a problem in appearance, but also causes serious impairment due to impaired organ function [2]. Exercise methods for such lateral flexion have been proposed for a long time [3] and are used to promote symmetrical development by elongating and strengthening the shortened muscles. [4]. In recent clinical trials, core stabilization exercises have been widely applied to patients with scoliosis and low back pain [5]. The core muscle is a trunk muscle such as the spine, pelvis, and abdomen, which generates all the strength and mobility of the human body. It is an exercise for stabilizing the spine by integrating the muscles along the center of the trunk [6]. These core muscles include the multifidus, pelvic floor musculature, diaphragm, and transverse abdominis. They limit the compression, distortion, and rotational forces between spinal segments. Moreover, all movements of the body are regulated because they provide support for the spine. The more stable your core, the more effective your body's energy can be used [8]. When the core is stable or unstable, the dispersion of force is markedly different. When the efficiency of the neuromuscular system decreases in the core and the force cannot be efficiently transmitted, movements of different forms appear to compensate for the insufficient force. This results in a bad posture during physical activity due to a decrease in stability [11]. Hence, this study aims investigate the effect of core stabilization exercises on Cobb's angle and balance ability in scoliosis patients.

2. Methods

This study was conducted from July to September 2019 with the permission of the institutional review board (IRB EU19-48) of Eulji University. Forty women, who were ≥20 years of age with a scoliosis angle of 10-25 degrees, were selected. However, only 33 patients were examined as seven dropped out from the study. Subsequently, they were divided into two groups by random selection: 17 under core stabilization exercise group and 16 under manual massage group. In the experiment, the core stabilization exercise was performed for 50 minutes and three times a week for a total of 8 weeks (Figure 1).

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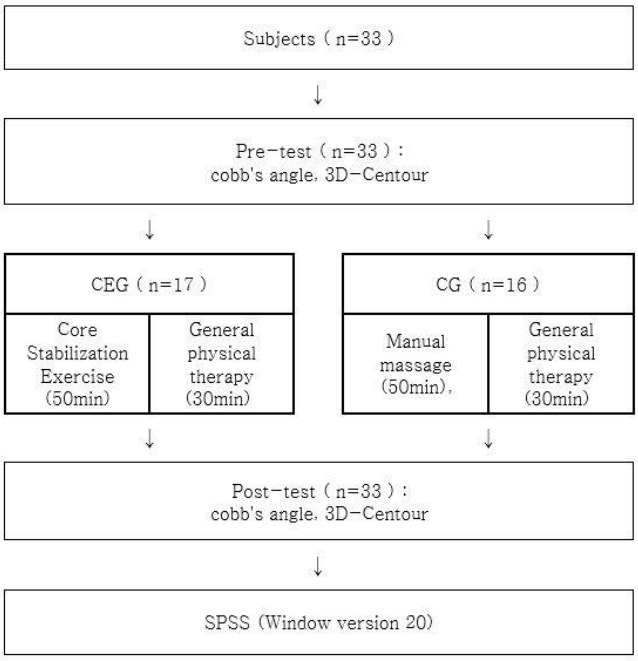

Figure 1. Summary of experiment for testing the effect of scoliosis correction

In both groups, 30 minutes of normal physical therapy such as superficial heat therapy, percutaneous electrical nerve stimulation therapy, and deep heat therapy, were done in parallel. The control group performed a basic manual massage (Figure

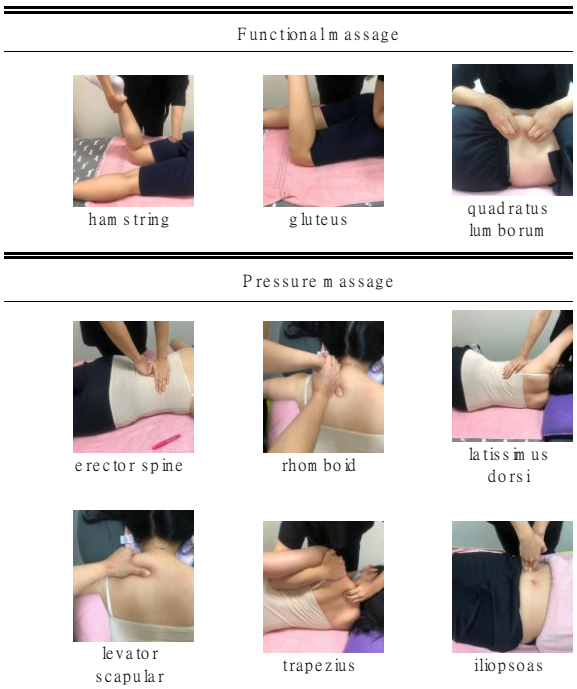

Figure 2. Manual massage practice picture

2). Meanwhile, the core stabilization exercise group included abdominal draw-in technique, maximum exhalation technique, Kegel exercise technique, and bridge posture. The knee and hip joints were flexed, and the arm was placed on the bed parallel to the body in a supine position.

The abdominal draw-in technique induced the navel to be pulled superiorly and posteriorly so that the abdomen is slightly pushed inwards during normal breathing. In this process, patients inhaled lightly and exhaled slowly for 10 seconds to gradually pull the belly button. The maximum exhalation technique was also maintained after exhaling at maximal capacity and induced the contraction of the transverse abdominal muscles. The Kegel exercise technique, which induces a similar sensation when holding urine, tightly squeezed and supported the pelvic floor muscles. In the bridge posture, the pelvis was lifted from the basic position until the knees and pelvic shoulders were aligned. At this time, abdominal draw-in and Kegel exercise maximum exhalation technique were performed together while maintaining a bridge posture (Figure 3). Similarly, training was conducted

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in advance for proper execution of the motion. In the manual massage group, functional massage was performed on muscles such as the hamstring, gluteus, and quadratus lumborum, while pressure massage techniques were used on muscles such as the erector spinae, iliopsoas, latissimus dorsi, trapezius, rhomboid, and levator scapula.

Figure 3. Abdominal draw-in technique under core stabilization exercise

2.1. Assessment Methods

For pre-post evaluation, changes in Cobb's angle were measured by X-ray imaging, while changes in static balance and dynamic balance were assessed using 3D-Centour. These were done by a professional radiologist.

For Cobb's angle measurement, the vertebrae at the upper and lower ends of the curve were determined first. Lines were then drawn at the top of the upper end vertebrae, at the bottom of the lower end vertebrae, and at right angles with respect to the first two lines. Afterwards, the corresponding intersection angle was determined (Figure 4).

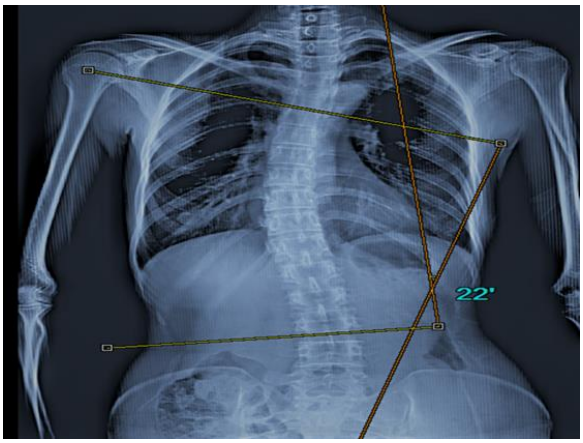

Figure 4. Measurement of Cobb`s angle

Dynamic balance was measured using equilibrium score, upper-lower, and left-right symmetrical distributions of body weight generated by 3D-Centour. Both groups were placed on the equipment while facing forward and arms crossed over their shoulders. Measurement was done after fixing the patient's pelvis and thigh. They were also requested to dress up and keep the posture while the inclination angle is changed during examination. However, this was dropped if the patient was unable to keep the posture or complained of pain during the test. The first measurement included the equilibrium scores while standing immediately with the eyes open for 20 seconds, and after resting with the eyes closed for 5 seconds. After measuring the equilibrium score, the dynamic balance was evaluated for the following: 20 seconds with the eyes open after 10 seconds of rest, and 20 seconds with the eyes closed after 5 seconds of rest. Interventions and tests were performed by physical therapists with more than 4 years of clinical experience (Figure 5).

Figure 5. Dynamic balance measured by 3D-Centour

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2.2. *Statistical analysis*

SPSS version 20.0 was used with a significance level of <0.05. Frequency analysis was performed to identify the general characteristics of the patients along with a homogeneity test using an independent t-test. Afterwards, both paired and independent t-test were used to compare the difference between before and after the intervention was applied in the experimental groups.

3. Results and Discussion

The Cobb's angle of the core stabilization exercise group decreased from 15.76±2.72 to 13.76±2.33 after the experiment ($p<0.01$). This result was similar with previous studies that reported that the Cobb's angle decreased after step-by-step training including core exercises [12]. In addition, the results were comparable to those studies conducted on adolescent idiopathic scoliosis patients with moderate curvature [13]. Hence, it was thought that the core stabilization exercise performed in this study had a positive effect by improving muscle movement and timing. Balance ability was measured by classifying it into static and dynamic balance. The static balance ability of front-back and left-right with eyes open increased from 66.76±6.41 to 71.00±5.54 ($p<0.01$), while those with eyes closed increased from 65.12±6.48 to 68.59±6.47 ($p<0.01$). The dynamic balance ability increased from 62.53±7.45 to 67.41±6.67 from the front-back, left-right with the eyes open ($p<0.01$), while those with eyes closed increased from 61.88±6.03 to 64.29±6.18. Therefore, a statistically significant difference can be seen from both static and dynamic balance abilities. The results of this study were similar with previous studies on improving the ability to control body balance and core stability exercise as an effective method in improving postural control [14,15-19]. Data also reveal that core muscles support the spine by limiting the twist and rotational forces while reducing the scoliosis angle of the patient with lateral flexion and maintaining the functional stability of the body. In future studies, long-term interventions for more than 8 weeks and various types of core stabilization exercise methods can also be considered to have a potentially greater effect on improving Cobb's angle.

The study has some limitations that need to be mentioned; this study was limited to patients with mild lateral flexion of the spine (10° to 25°), where the Cobb's angle was not as severe as a result of X-ray measurement, and individual differences in scoliosis curves and directions were excluded. However, it is recommended that future studies should apply the method for different patients with various types of lateral flexion.

Table 1. Cobb's angle and Balance Changes

		CEG (n=17)	MSG (n=16)	t	p
Cobb's Angle	Pre	15.76±2.72	17.81±2.99	4.479	0.00
	Post	13.76±2.33	17.56±2.75		
	t	6.46	1.07		
	p	0.00	0.30		
Eye Open Static Balance	Pre	66.76±6.41	68.88±5.73	3.773	0.001
	Post	71.00±5.54	69.63±5.45		
	t	4.926	2.818		
	P	0.00	0.013		
Eye Close Static Balance	Pre	65.12±6.48	67.31±4.94	3.818	0.001
	Post	68.59±6.47	67.69±4.79		
	t	4.733	1.246		
	p	0.00	0.232		
Eye Open Dynamic Balance	Pre	62.53±7.45	67.44±5.97	4.981	0.000
	Post	67.41±6.67	67.94±6.19		
	t	5.940	2.070		
	p	0.00	0.056		
Eye Close Dynamic Balance	Pre	61.88±6.03	65.63±5.80	3.013	0.005
	Post	64.29±6.18	66.13±6.30		
	t	4.750	1.826		
	p	0.00	0.088		

Values are M±SD $p<0.05$
a: Independent T-test, b: Paired T-test
CEG: Core Exercise Group; MSG: Manual Massage Group

4. Conclusion

The purpose of this study was to investigate the effect of core stabilization exercises performed for scoliosis patients on Cobb's angle and balance. As a result of this study, core stabilization exercises were significant effects on scoliosis patients. Therefore, it was found out that core stabilization exercise was more effective the Cobb's angle and balancing ability than manual massage. Hence, core stabilization exercise may be a good option during the management and treatment of scoliosis patients. It is thought that a further study of core stabilization exercise on pain, breathing, and activities of daily living in scoliosis patients

is necessary.

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Conflict of Interest: Sang Woong Park and Junghyun Kwon contributed equally to this work.

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