Psychological and Physical Effects of Schroth and Pilates Exercise on Female High School Students with Idiopathic Scoliosis

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Purpose: The purpose of this study is to investigate effects of psychological factors on Schroth exercise and Pilates exercise to female high school students with idiopathic scoliosis.

Methods: Sixteen subjects with over 20 of Cobb's angle were randomly divided into Schroth exercise group (SEG, n = 8) and Pilates exercise group (PEG, n = 8). Both training programs were carried out 3 day a week for 12 weeks. Psychological factors were measured using depression scale, self esteem scale and body esteem scale.

Results: Both groups showed significant differences in depression scale, self esteem scale and body esteem scale. Schroth exercise group showed greater improvement than Pilates group.

Conclusion: Having correct body image affects psychological factors to growing students. Schroth exercise is more effective method to physical and psychological approach of idiopathic scoliosis.

Keywords: Schroth exercise, Pilates exercise, Scoliosis

INTRODUCTION

As modern adolescents are paying increasing attention to their outer appearance and health, the importance of physical exercise has also increased. The excessive competition in relation to school performance, beginning during early elementary school, has led to increased study time, and the long-term use of computers during such study can lead to poor body positions and imbalance, and this can progress to scoliosis if it becomes chronic.¹

Scoliosis refers to a three-dimensional deformation of the spine in which the normal curvature of the sagittal plane is lost due to the rotation of the vertebral body and the deformation of the spine on the front body, and scoliosis is defined as a Cobb's angle of 10° or greater.² About 85% of scoliosis cases are idiopathic, as the cause is unknown. Idiopathic scoliosis is found most frequently during adolescence when the growth rate is highest. Early detection of scoliosis is critical for decreasing the incidence rate because joint flexibility

Received Nov 16, 2016 Revised Dec 29, 2016 Accepted Dec 30, 2016 Corresponding author Pil-Neo HwangBo E-mail pt486pn@naver.com increases as the musculoskeletal system grows rapidly, and the body posture can easily become deformed during adolescence.^{3,4}

In South Korea, scoliosis has been increasing among middle school and high school students. The incidence rate of scoliosis is seven times higher in female students, who are more interested in beauty and physical appearance and are more psychologically sensitive than male students.^{5,6} Dissatisfaction with body shape in physically and mentally immature adolescents can lead to a loss of selfidentity, which can severely exacerbate mental health issues.¹

Jin⁸, one of the previous studies of the correlation between scoliosis and Psychological factors, reported patients with adolescent scoliosis need to treat aggressively because adolescents are vulnerable and scoliosis can make behavior problems by emotional impact, social solitary and physical pain. Adolescents growing up with scoliosis have negativity and poor body image, so those have several restrictions of social activity and sometimes these social psychological problems can be more restrictions than physical pain.⁹ Scoliosis pa-

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tients in puberty have been reported to have a lower level evaluation of their own physical body than healthy people, and patients with back pain have been reported to have a higher incidence rate of depression, while severe back pain can have a seriously negative effect on social activities.¹⁰ Dissatisfaction with physical appearance can not only lead to emotional tension or changes in personality but also to decreased self-esteem, which can result in an increased risk of a loss of self-consciousness.¹¹ Self-esteem and self-evaluation are greatly affected by physical characteristics; in particular, physical image and self-confidence in terms of appearance have a great effect on body-esteem.12

Schroth exercise has come to the fore as a therapeutic approach for scoliosis. Schroth exercise has been reported to be effective in achieving a partial recovery of secondary scoliosis factors, and it significantly reduces the Cobb's angle and pain.¹³ Pilates exercise has been reported to correct body postures, strengthening the muscles needed to maintain correct positions, body flexibility, and balance through vertebral segment exercise; this can help improve quality of life by improving metal health, which can positively influence other aspects of life.14,15

Many previous studies have shown that Schroth exercise and Pi-

Table 1. S	Schroth	& Pilates	exercises	program
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lates exercise effectively improve the Cobb's angle in patients with scoliosis, but the effect of these exercises on psychological factors has not yet been investigated. The present study was conducted to investigate the effect of these types of exercise on the psychological factors of patients with scoliosis, particularly in relation to the improvement of the Cobb's angle.

METHODS

1. Subjects

The present study was conducted with 16 female high school students with scoliosis characterized by a Cobb's angle of 20° or greater; they voluntarily participated in the study from January to April 2015 at the S Sports Center in Daegu. The subjects were provided a sufficient explanation of the purpose and methods of the present study, and they voluntarily consented to participate. Individuals were excluded as subjects from the present study if they were being administered drugs or if they had visual, vestibular organ, or neurological impairments; wore a brace for the correction of scoliosis; were currently participating in another exercise program; or had a musculoskeletal or mental disorder.

	Schroth exercise program	Pilates exercise program
Warm up (10 min)	- 3D breathing exercise	- Pilates breathing exercise
	- Cat walking	- Learn posture according to the posture of the spinal column
Main Exercise (45 min)	- Shoulder counter traction in side-lying	- Stretching the concave part by overball (mat)
	- Shoulder counter traction in prone	- Single elbow up (mat)
	- Shoulder counter traction with elastic band in sitting	- Side stretch & mermaid (Reformer)
	- Muscle cylinder in sitting	- Double & single arm push ups (chair)
Cool down (5 min)	- Moving ribs	- Spine segment movement

- Moving ribs

Spine segment movement

2. Experimental method

1) Experimental procedures

A radiograph instrument (CR 85-X, USA) was used to measure the Cobb's angle of the subjects in a standing position; a picture archiving and communication system (PACS) for medical images was used to measure the angle. The subjects' psychological factors were analyzed based on the questionnaire completed by the subjects on depression, self-esteem, and body-esteem inventories. The 16 subjects were randomly allocated to the Schroth exercise group (SEG) (eight subjects) or the Pilates exercise group (PEG) (eight subjects). The exercise programs consisted of a warm-up exercise, a main exercise, and a warm-down exercise. The exercise programs were implemented for 12 weeks, three sessions per week, and the test values before and after the exercise programs were compared for analysis (Table 1).

2) Measurement inventory and measurement method

The Cobb's angle was measured using a radiograph (CR 85-X, USA) and a PACS. The radiographic images were taken while the subjects were standing. A questionnaire surveyed the subjects regarding specific psychological factors, utilizing depression, self-esteem, and body-esteem inventories. The level of depression was measured using a Korean version of the beck depression inventory (BDI). In measur-

Table 2.	The	general	characteristics	of	subjects
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	SEG (n=8)	PEG (n=8)
Gender (female)	Female (n=8)	Female (n=8)
Age (year)	18.14±1.60ª	18.88±1.55
Weight (kg)	50.14±8.26	51.06±9.97
Height (cm)	162.86±7.35	163.19±8.04
Cobb's angle (°)	22.07±6.81	21.20±3.95

SEG: Schroth exercise group, PEG: Pilates exercise group. ^amean±SD.

Table 4. Comparison of psychological factors scales in each groups

ing the internal consistency of the questions, the reliability and the split-half reliability were $\alpha = 0.8679$ and r = 0.8572, respectively. Selfesteem was measured using a self-esteem inventory (SEI) that was prepared by revising and supplementing Coopersmith's SEI, and the reliability coefficient (Cronbach's α) of the inventory was 0.81. Body-esteem was measured using a body-esteem scale (BES) that was prepared by revising and supplementing the BES developed by Mendelson and White to ensure suitability for adolescents. The reliability coefficient (Cronbach's α) of the BES was 0.74.

3. Analytical method

SPSS version 18.0 was used to calculate the average and standard deviation of the individual measurement items with regard to the Cobb's angle and the psychological factors (BDI, SEI, and BES) before and after the experiment. A paired t-test was performed to compare the changes before and after the experiment within each group. An independent t-test was performed to compare the changes before and after the groups. The significance level (α) was set at 0.05.

RESULTS

1. General characteristics of subjects

Table 2 shows the general characteristics of the subjects. No sig-

Table 3. Comparison of Cobb's angle in each groups

	Pre-test	Post-test	difference value	Pre-test	
SEG	22.07±7.31ª	14.27±6.13	7.80±4.38	3.57*	
PEG	21.20±5.32	18.73±5.23	3.57±2.25	3.84*	
t	2.74		3.73*		

SEG: Schroth exercise group, PEG: Pilates exercise group. "mean \pm SD, *p < 0.05.

		Pre-test	Post-test	difference value	Pre-test
BDI	SEG	24.73±3.17ª	13.93±1.39	-10.80±2.62	-17.42*
	PEG	23.73±2.09	15.60±1.18	-8.13±2.07	-17.13*
	t	1.02		-3.09*	
SEI	SEG	86.6±2.59	91.8±1.78	5.20±2.42	17.29*
	PEG	87.53±1.64	89.87±1.13	2.33±1.07	11.02*
	t	0.08		2.87*	
BES	SEG	25.20±1.82	32.13±1.30	6.93±1.28	20.98*
	PEG	26.60±1.45	32.07±1.03	5.47±1.92	11.01*
	t	-1.33		2.46*	

BDI: beck depression inventoty, SEI: self-esteem invertory, BES: body-esteem scale. ^amean \pm SD, $^{*}p < 0.05$. nificant differences were found in terms of age, height, weight, and Cobb's angle between the two groups (p > 0.05).

2. Comparison of Cobb's angle between the SEG and PEG

An analysis of the effect of the exercise programs showed that the Cobb's angle was significantly different before and after the exercise program in both the SEG and PEG (p < 0.05). A comparison of the changes in the two groups before and after the exercise program showed a significant difference between the two groups (p < 0.05) (Table 3).

3. Comparison of psychological factors in the SEG and PEG

An analysis of the effect of the exercise programs showed significant differences in BDI, SEI, and BES before and after the exercise programs in both the SEG and PEG (p < 0.05). A comparison of the changes in the two groups before and after the exercise program showed a significant difference between the two groups (p < 0.05) (Table 4).

DISCUSSION

The present study was conducted to determine the psychological effect of therapeutic intervention on patients with scoliosis by comparing the effect of exercise programs on female high school students with scoliosis during their most psychologically sensitive period of life. The study utilized intra-group and inter-group comparisons before and after the implementation of the exercise programs to measure the psychological effect of these interventions.

Recently, kinesiotherapy has been reported in many publications as a conservative treatment method for scoliosis; the therapeutic effect of kinesiotherapy has been reported to increase in patients with a large Cobb's angle who are coping with the deformation by themselves.¹⁶ In addition, the therapeutic effect is primarily based on changing the appearance, in particular reduction of the protruding back.¹⁷ The present study shows that the Cobb's angle was significantly changed in the SEG and PEG. An inter-group comparison of the changes before and after the exercise programs found that the Cobb's angle decreased significantly more in the SEG than in the PEG. Numerous previous studies have shown that Schroth exercise significantly changes the Cobb's angle when used to treat scoliosis.^{18,19} Emery et al. reported that a 12-week Pilates exercise program improved the Cobb's angle and the overall angle of the vertebra.¹⁴ However, most previous studies on Pilates exercise were conducted with patients with mild scoliosis. The results of the present study, in which the subjects were scoliosis patients with a Cobb's angle of 20° or greater, show that the Cobb's improved significantly more in the SEG than in the PEG.

In the present study, the BDI, SEI, and BES showed significant changes in both the SEG and PEG, but the effect was more significant in the SEG than in the PEG.

Desaha et al²⁰ investigated the correlation between exercise and depression in adolescents and reported that the depression level was higher in female subjects than in male subjects, and they found that participation in exercise had a positive effect in terms of reducing depression. Danielsson et al²¹ conducted a study on patients with pubescent idiopathic scoliosis undergoing a brace-based treatment and reported that the social isolation, depression, and decreased leisure activities caused by the treatment reduced the patients' quality of life. Hong et al²² reported that children with scoliosis showed higher stress scores and lower learning attitude scores than children without scoliosis. Therefore, psychological factors are presumed to correlate with physical changes, which is reflected in the present study's findings that an improvement in the Cobb's angle had a psychologically therapeutic effect.

In conclusion, both Schroth exercise and Pilates exercise improved the Cobb's angle and had a positive psychological effect on patients with scoliosis, but the comparison between the SEG and PEG showed that Schroth exercise was more effective. It is critical for individuals to establish a sound image of their physical bodies in order to ensure psychological stability during the period in which pubescent changes occur. Schroth exercise is found to be effective for physical and psychological treatment of moderate idiopathic scoliosis in patients with a Cobb's angle of 20° or greater.

The present study has some limitations. First, the number of subjects was not large because the subjects were busy high school students. Second, only female high school students were included in the subject group; male high school students were excluded. Future studies, from a preventive-medicine point of view, should be conducted with various subject groups, as they could greatly contribute to the physical and mental welfare of patients with scoliosis and improve their quality of life.

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