Effect of a 16-Week Yoga Program on Cobb’s Angle in Female Patients with Scoliosis

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ABSTRACT

BACKGROUND Long-term postural imbalances can promote the development of diseases such as scoliosis or pain in the neck, shoulders, arms, and lumbar spine. Yoga combines exercises that target muscular strength and flexibility, suggesting that it can aid in attenuating structural and postural imbalances without the need for invasive procedures. The present study aimed to investigate the effect of a 16-week yoga program on Cobb’s angle and other postural indicators in patients with scoliosis.

METHODS Ten middle-aged women living in South Korea who were judged to have scoliosis based on the results of posture tests participated in a 16-week yoga program. It consisted of two 70-min sessions per week during weeks 1–4, two 80-min sessions per week during weeks 5–9, and two 90-min sessions per week during weeks 10–16. The heights of the ilium and ischium were measured to check for pelvic imbalances. Shoulder height and Cobb’s angle in the spine were also assessed on radiography both before and after the intervention.

RESULTS Following the 16-week program, Cobb’s angle had significantly decreased from 10.50±4.26 to 7.05±3.37 (p<0.001). However, there were no statistically significant differences between pre- and post-intervention shoulder height (pre: 2.85±1.76 mm; post: 1.58±0.99 mm; p=0.124). In contrast, iliac height had decreased from 2.62±1.33 mm to 1.78±0.80 mm (p=0.048), and ischial height had decreased from 1.72±0.92 mm to 1.17±0.80 mm (p=0.043), and both differences were significant.

CONCLUSIONS These results suggest that regular participation in yoga is effective for maintaining or improving postural indicators and attenuating imbalances in middle-aged women with scoliosis.

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physiological, and mental health, highlighting its value as an alternative to traditional exercise-based rehabilitation interventions [4-6]. For example, through yoga training, it helped treat low back pain and develop balance [7], applied 15-week yoga exercises to high school students complaining of spinal discomfort to identify the effects of body flexibility and posture management, and correct alignment of back pain and body skeleton. It came out, and it was said that there may be differences in effectiveness depending on individual efforts [8].

Most postural imbalances are acquired and tend to progress with age, highlighting the need for appropriate exercise interventions and education for preventing such progression. Yoga combines exercises that target muscular strength and flexibility, suggesting that it can aid in attenuating structural and postural imbalances without the need for invasive procedures. However, few studies have examined the ability of yoga to address postural imbalances in patients with scoliosis. Therefore, in this study, we aimed to examine whether a 16-week yoga intervention could mitigate postural imbalances involving the shoulder, spine, and pelvis in middle-aged women with scoliosis.

Materials and Methods

Patients

The study included 10 middle-aged women living in South Korea who were judged to have scoliosis based on the results of posture tests. The sample size was determined by performing one-way analysis of variance using G*Power software (version 3.1.9.7, Heinrich-Heine-University, Germany) to obtain the optimal power (1-beta) and significance level (p=0.05)[9]. Prior to participation in the study, patients received a full explanation regarding the study’s purpose and procedures. After confirming their understanding, all patients voluntarily provided written informed consent for participation. The study protocol was approved by the ethics committee of Dongguk University of Korea (IRB number 20220002) and conformed to the standards set by the latest revision of the Declaration of Helsinki. The physical characteristics of the study participants are shown in Table 1.

| Table 1. General characteristics of the included patients |
|---|---|---|---|---|
| Patients (n) | Age (years) | Height (cm) | Weight (kg) | Body mass index (kg/m²) |
| 10 | 57.60±4.73 | 165.0±1.24 | 60.7±7.61 | 27.0±1.50 |
| Data are expressed as the mean±standard deviation |

Measurements

Digital photo posture test

A posture viewer (Wall Screen, Balance body, Korea) was installed on the wall, and images of each patient were obtained from the front and back, with the patient in the upright position standing 3 m away. The digital photos were then assessed for symmetry between the right and left sides by drawing a vertical line at the midpoint between the feet and the height of the shoulders. Vertical lines were drawn through the posterior axillary folds. The points at which these lines intersected with the shoulders were regarded as the reference points [10]. The difference in height between these points in millimeters was measured as clinical index of shoulder balance. Figure 1 shows the procedure for the postural assessment.

Figure 1. Digital photographs were used to evaluate standing posture. (a) Vertical lines were drawn through the posterior axillary folds. (b) The difference in height between the horizontal lines was measured at the point at which the vertical lines intersected as a clinical index of shoulder balance.
X-ray measurements

X-rays were obtained at Gyeongju hospital (Gyeongsangbukdo, Korea) using a digital imaging system (CXD-R185, JW medical, Korea), with patients standing on the X-ray scaffold in a natural, comfortable position. Measurements were obtained without providing comments regarding the patient's standing position or posture. Patients inhaled and exhaled in accordance with the instructions provided by the assessor, who then obtained photographs during breath holding following inspiration. The detailed X-ray measurement site is shown in Figure 2. Shoulder balance was assessed by comparing the heights of horizontal lines drawn at the end of the left and right acromion protrusions [11].

Cobb’s angle measurements in the spine

Although there are various methods for spinal measurement, the most widely utilized is the Cobb's method, in which the angle of crossing is determined by measuring the greatest spinal inclination at the top and bottom of the curve, drawing one line at the top of the upper end and the other at the bottom of the lower end [12,13].

Measurement of pelvic imbalances

Using the Gonstead method [14], the heights of the ilium and ischium were measured using a horizontal ruler as shown in Figure 2. To determine iliac height, the highest parts of the left and right iliac bones were marked and compared using a horizontal line. To determine ischial height, the bottom of the ischial nodule was marked on the left and right sides, which were compared by drawing a horizontal line.

Yoga program

The 16-week yoga program included two 70-min sessions per week during weeks 1–4, two 80-min sessions per week during weeks 5–9, and two 90-min sessions per week during weeks 10–16. Sessions were conducted as shown in Table 2 on Mondays and Thursdays. The instructor introduced participants to yoga postures and called attention to ways in which postures could improve spine, shoulder, and pelvic imbalance while guiding them in adapting postures and using props to accommodate physical limitations as needed. In addition to attending group classes, participants were asked to practice yoga at home for at least 1 additional hour per week. Participants were also provided a written manual that included pictures and descriptions of each yoga posture to guide home-based practice, as well as a yoga mat to use at home.

Statistical analysis

Descriptive variables are presented as mean±standard deviations. Data were analyzed using paired samples t-test, with statistical significance set at p<0.05. SPSS 21.0 (IBM, Armonk, NY, USA) was used to perform all analyses.

Results

Table 3 shows the change in the angle of the spine...
The decrease in Cobb’s angle from 10.50±4.2° to 7.05±3.37° was statistically significant (p<0.001). However, the difference between pre- and post-intervention shoulder height was not significant (pre: 2.85±1.76 mm; post: 1.58±0.99 mm; p=0.124). In contrast, iliac height had decreased from 2.62±1.33 mm to 1.78±0.80 mm (p=0.048), while ischial height had decreased from 1.72±0.92 mm to 1.17±0.80 mm (p=0.043), and both differences were significant.

## Discussion

Following the back, the shoulder area is the most common site of pain in young people, including middle and high school students [15]. Habitual and occupational factors that bias posture to one side are common causes of postural imbalances [16,17], and research suggests that muscles stiffen in an attempt to prevent the imbalance from progressing, resulting in decreased flexibility. Previous studies have reported that various exercise programs are effective in correcting shoulder imbalances [18,19]. In particular, the beneficial effects of medical yoga have been documented for various chronic musculoskeletal diseases [20-22]. In this study, although shoulder height decreased from 2.85±1.76 mm to 1.58±0.99 mm following the 16-week intervention, this difference was not statistically significant. However, the average values for shoulder imbalances tended to decrease, likely due to repeated activation of the surrounding muscles in the correct posture during the intervention. In addition, 9 of 10 participants exhibited positive changes in heights of the left and right shoulders, although worsening of the imbalance was noted in one participant. Improvements in pelvic and spinal alignment may explain the greater changes in shoulder height. These results suggest that regular physical activity can correct

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### Table 2. Yoga program

<table>
<thead>
<tr>
<th>Twice a week (16 weeks)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>Thursday</td>
</tr>
<tr>
<td>Warm up</td>
<td>1–4 week</td>
</tr>
<tr>
<td>Tadasana</td>
<td>Virabhadrasana</td>
</tr>
<tr>
<td>Trikonasana</td>
<td>Uttihita Parsvakonasana</td>
</tr>
<tr>
<td>Salabhasana</td>
<td>Jathara Parivartanasana</td>
</tr>
<tr>
<td>Utkatasana</td>
<td>Baddha Konasana</td>
</tr>
<tr>
<td>Adho Mukha Svanasana</td>
<td>Halasana</td>
</tr>
<tr>
<td>Ardha Matsyendrasana</td>
<td>Matsyasana</td>
</tr>
<tr>
<td>Ardha Dhanurasana</td>
<td>Marjariasana</td>
</tr>
<tr>
<td>Pascimottanasana</td>
<td>Supa Padangusthasana</td>
</tr>
<tr>
<td>Virabhadrasana</td>
<td>Uttihita Padangusthasana</td>
</tr>
<tr>
<td>Ustrasana</td>
<td>Setu Bandhasana</td>
</tr>
<tr>
<td>Paripurna Navasana</td>
<td>Upavistha Konasana</td>
</tr>
<tr>
<td>Swimming/Curl up pose</td>
<td>Double leg lift</td>
</tr>
<tr>
<td>Reverse Crunch</td>
<td>Pilates Hundreds</td>
</tr>
<tr>
<td>Cool down</td>
<td>10 minutes</td>
</tr>
</tbody>
</table>

### Table 3. Changes in Cobb’s angle following the 16-week yoga intervention (n=10)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Pre</th>
<th>Post</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cobb’s angle (°)</td>
<td>10.50±4.26</td>
<td>7.05±3.37</td>
<td>4.978</td>
<td>&lt;0.001***</td>
</tr>
<tr>
<td>Shoulder height (mm)</td>
<td>2.85±1.75</td>
<td>1.58±0.99</td>
<td>1.698</td>
<td>0.124</td>
</tr>
<tr>
<td>Iliac height (mm)</td>
<td>2.62±1.33</td>
<td>1.78±0.80</td>
<td>2.291</td>
<td>0.048*</td>
</tr>
<tr>
<td>Ischial height (mm)</td>
<td>1.72±0.92</td>
<td>1.17±0.80</td>
<td>2.351</td>
<td>0.043*</td>
</tr>
</tbody>
</table>

Data are expressed as the mean±standard deviation

*p<0.05; ***p<0.001, paired samples t-test
long-term postural imbalances at the shoulder in middle-aged women.

Since spinal deformation progresses slowly, it is often found only after a considerable progression. Elevation of the shoulder or scapula on one side is associated with deviation of the spine in the lateral direction. These postural disturbances can lead to imbalances in the joints that limit movement of the ligaments and muscles, eventually making normal movements difficult and cause pain [23,24]. In this study, Cobb's angle in the spine significantly decreased from 10.50±4.26° to 7.05±3.37° after the 16-week intervention (p<0.001). Several previous studies have reported the positive effects of yoga-based interventions in patients with scoliosis [25-27], particularly with respect to Cobb's angle [28,29]. Our findings are consistent with the previous studies showing that yoga interventions can decrease Cobb's angle in the spine and correct postural imbalances, which may help to improve flexibility, prevent muscle and joint disorders, and increase muscle elasticity.

In this study, we also investigated changes in iliac and ischial height to determine the influence of the yoga intervention on pelvic imbalances. The difference in height between the left and right iliac bones decreased significantly from 2.62±1.33 mm to 1.78±0.80 following the intervention. Similarly, the difference in ischial height decreased significantly from 1.72±0.92 mm to 1.17±0.80 mm. These results suggest that regular participation in yoga can help correcting pelvic imbalances and posture by increasing flexibility and muscle strength via the activation of unused muscles.

The present study had some limitations, including the lack of a control group and small sample size. In addition, we did not analyze eating habits or control for other forms of physical activity in daily life. Further, as the study included middle-aged women only, the results may not be generalizable to other populations. Lastly, further studies are required to analyze the relationships among scoliosis, pelvic imbalances, and shoulder imbalances.

Conclusions

The current study suggests that a 16-week yoga exercise program can improve postural imbalances based on Cobb’s angle in the spine, shoulder height, and iliac/ischial height in middle-aged women with scoliosis. These improvements may be related to the repeated contraction and relaxation of muscles that are not usually activated, which may help to improve flexibility and muscular balance at each joint. Therefore, regular participation in yoga may represent an effective method for maintaining and/or improving posture in middle-aged women with scoliosis, without the need for invasive interventions.

References and Notes

7. Carmody J, Baer RA. Relationships between mindfulness practice and levels of mindfulness, medical and


26. Park YH, Park YS, Lee YT, Shin HS, Oh MK, Hong J, et al. The effect of a core exercise program on Cobb angle and

