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The Impact of Breast Size on the Vertebral Column: A Radiologic Study

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Abstract.
Background: Macromastia usually is associated with the physical and psychological symptoms reported comprehensively by many studies. Reduction mammoplasty seems to be the most reasonable solution for these symptoms, and many articles have reported improvement of these complaints after surgery. Some authors have postulated that the anatomic mechanisms of postural aberrations are heavy breasts and related pain symptoms. However, limited numbers of studies have tried to explain the effect of the heavy breasts on the vertebral column.
Methods: This study enrolled 100 females in four groups according to their breast cup sizes (groups A, B, C, D). All four groups were compared with each other statistically using one-way analysis of variance (ANOVA) followed by a post hoc test according to the body mass index (BMI) as well as the thoracic kyphosis, lumbar lordosis, and sacral inclination angles.
Results: The BMI was significantly higher in the D cup–sized breast group. There was a statistically significant difference between groups A and D in terms of the thoracic kyphosis and the lumbar lordosis angles, and between groups B and D in terms of the lumbar lordosis angle. No statistically significant difference was detected between the groups in terms of the sacral inclination angle.
Conclusion: Breast size seems to be an important factor that affects posture, especially the thoracic kyphosis and lumbar lordosis angles.

Key words: Back pain—Breast size—Posture—Vertebral column

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Physical and psychological symptoms associated with macromastia have been reported by many studies published especially in the past two decades. Most of these studies have noted that heavy breasts could cause severe physiologic symptoms including submammary intertrigo, bra strap chafing, reduced areola–nipple sensation, numbness in fingers, breathing disorders, and pain resulting from poor body posture (headache as well as neck, shoulder, lower back and breast pain). Other problems include difficulty finding suitable clothes, limitation during daily or sport activities, and uncomfortable feelings in body image and sexual relationships [1,3,4,7,8,12,14,15].

Many of the aforementioned studies also have stated that reduction mammoplasty could improve patients' health status and quality of life [1,3,4,7,8,12,14,15]. Currently, on the basis of these studies, most insurance companies cover the expenses of reduction mammoplasties in which the resection weights exceed 350 g [2].

On the other hand, almost all of these studies obtain data by the help of a questionnaire, which includes preoperative and postoperative subjective measurements about the physical and psychological symptoms. A limited number of studies try to explain the anatomic mechanisms of the pain, and these studies all include theoretical explanations about the relationship between the pain and the posture [9,10]. To our knowledge there is not sufficient objective data about the effect of breast size on posture. We designed a radiologic study to analyze postural aberrations of the back and lower back regions caused by breast size.

Materials and Methods

The study enrolled 100 female volunteers. All the volunteers gave an informed consent, and ethical

approval was obtained for this study. The study excluded patients with systemic or vertebral diseases who had undergone spinal surgery or were using any medication. Patients younger than 18 years of age and postmenopausal patients (because postmenopausal osteoporosis is a main cause of the postural aberrations) were not included in the study [5,11,13,16]. Pregnant women were excluded because of possible x-ray damage to the fetus and vertebral alignment changes during the pregnancy [6].

Age, height, and weight as well as underband and overbust measurements for breast sizes were recorded for each participant. Then lateral radiographs of the thoracic and lumbosacral regions were obtained with the patients in a relaxed upright standing position without shoes.

Body mass indexes (BMI) were calculated for every patient using the following formula: weight/height^2 (kg/m^2). Cup sizes also were determined for every individual by calculating the difference between the overbust and underband measurements as follows: <6.5 cm (A cup size), 6.5 to 13 cm (B cup size), 13−19.5 (C cup size), and >19.5 (D cup size). On the lateral radiograph, the thoracic kyphosis angle (the angle between the planes of the superior end plate of the 1st thoracic vertebra and the inferior end plate of the 12th thoracic vertebra) and the lumbar lordosis angle (the angle between the planes of the superior end plate of the 1st lumbar vertebra and the superior line of the sacrum) were determined using Cobb's method [18]. The sacral inclination angles were determined by measuring the angle between the superior line of the sacrum and the horizontal line [18] (Fig. 1). A single physician blinded to the cup sizes of the patients performed all the measurements.

The results are presented as means, standard deviations, and ranges. Statistical analyses of the differences between groups were performed with one-way analysis of variance (ANOVA) followed by a post hoc test and Pearson correlation analysis using computerized statistical software (SPSS Version 13, SPSS Inc., Chicago, IL, USA). Differences between the groups in terms of these angles and clinical parameters such as age, BMI, and the relationship between the thoracic kyphosis angle, the lumbar lordosis angle, and the sacral inclination angle were analyzed.

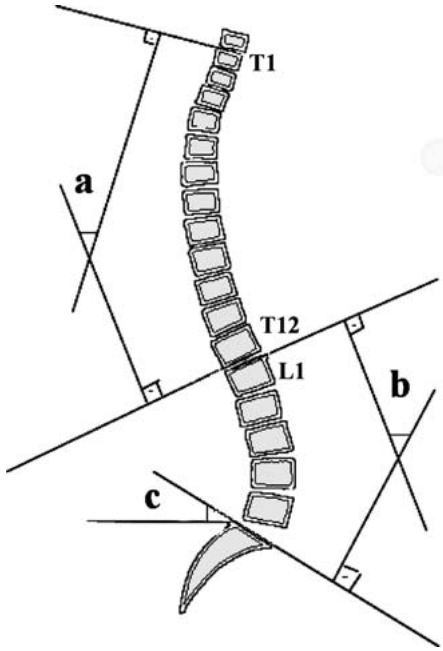

Fig. 1. Schematic drawing for the measurements of vertebral angles on the lateral x-ray. (**a**) Thoracic kyphosis angle. (**b**) Lumbar lordosis angle. (**c**) Sacral inclination angle.

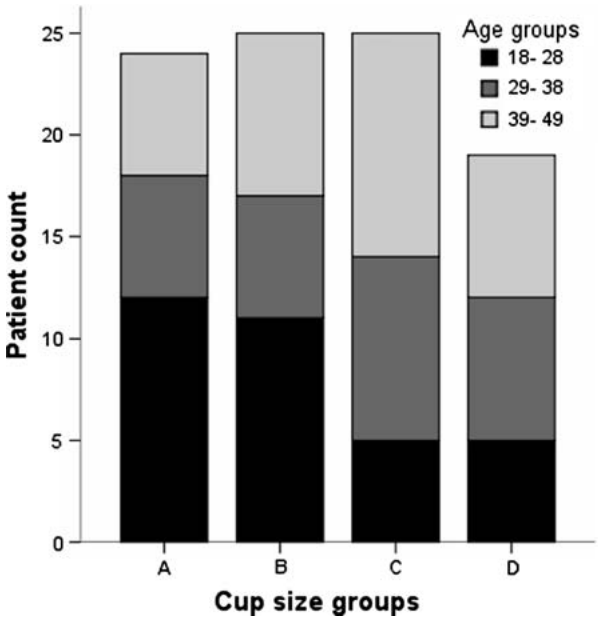

Fig. 2. Age distribution between cup size groups. There is no significant difference between the groups by means of age ($p > 0.05$, ANOVA).

Results

Seven patients were excluded because of inappropriate radiographs. The remaining 93 patients were divided into four groups according to their breast cup sizes (groups A, B, C, and D). The mean age was 33.7 years (range, 18−49 years). The age distribution was homogenous between groups A, B, C, and D (Fig. 2). The BMI ranged between 18 and 33 kg/m^2 (mean, 25.0 ± 3.6 kg/m^2). There were 25 patients in groups A and C, 24 patients in group B, and 19 patients in group D. The overall mean thoracic kyphosis angle was 39.0° ± 8.1° (range, 15−56°). The mean lumbar lordosis angle was 55.6° ± 7.3° (range, 36−71°), and the mean sacral inclination angle was 34.7° ± 5.8° (range, 23−52°).

The thoracic kyphosis angle was highest in group D and lowest in group A, and the difference between the two groups was statistically significant ($p = 0.023$, ANOVA). The lumbar lordosis angle

was highest in group D, and lowest in group B, and the difference between groups A and D ($p = 0.045$, ANOVA) and between groups B and D was statistically significant ($p = 0.008$, ANOVA). There was no statistically significant difference between the groups for the sacral inclination angles ($p > 0.05$, ANOVA) (Fig. 3). A positive correlation was detected between the thoracic kyphosis and lumbar lordosis angles, and between the lumbar lordosis and sacral inclination angles. However, there was no correlation between the thoracic kyphosis and sacral inclination angles ($p > 0.05$, ANOVA).

The patients were divided into three groups according to their ages. There were 33 patients in group 1 (ages 18–28 years), 28 patients in group 2 (ages 29–38 years), and 32 patients in group 3 (ages 39–49 years). There was no statistically significant difference between the age groups in terms of thoracic kyphosis, lumbar lordosis, or sacral inclination angles ($p > 0.05$, ANOVA) (Fig. 4).

The BMI for group D was significantly higher than that for group A ($p < 0.01$, ANOVA), group B ($p = 0.038$, ANOVA), or group C ($p < 0.01$, ANOVA) (Fig. 5). The patients were divided into four groups according to their BMI. There were 4 patients in group 1 (underweight), 47 patients in group 2 (normal weight), 33 patients in group 3 (overweight), and 9 patients in group 4 (obese). Unexpectedly, no statistically significant difference was found between the BMI groups in terms of thoracic kyphosis, lumbar lordosis, and sacral inclination angles ($p > 0.05$, ANOVA) (Fig. 6).

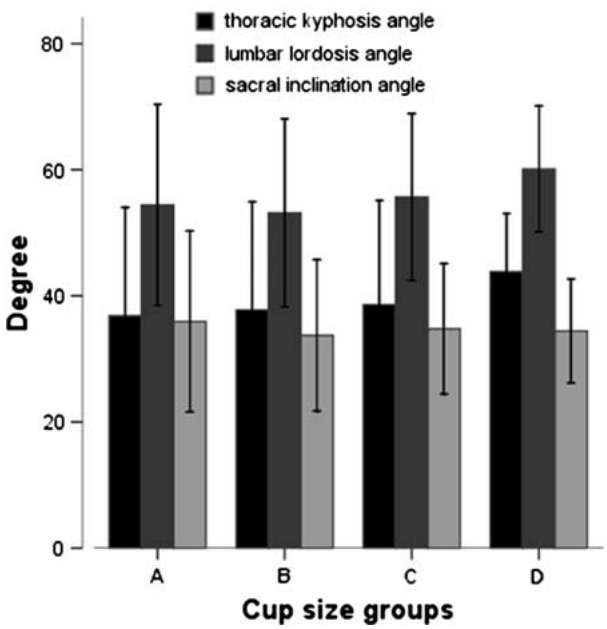

Fig. 3. The vertebral angles of the cup size groups are shown. The differences between the thoracic kyphosis angles of group A and D, and between the lumbar lordosis angles of group A and D as well as groups B and D are significant ($p < 0.05$, ANOVA) There is no significant difference between the sacral inclination angles of the groups ($p > 0.05$, ANOVA) (T above the bar depicts standard deviation).

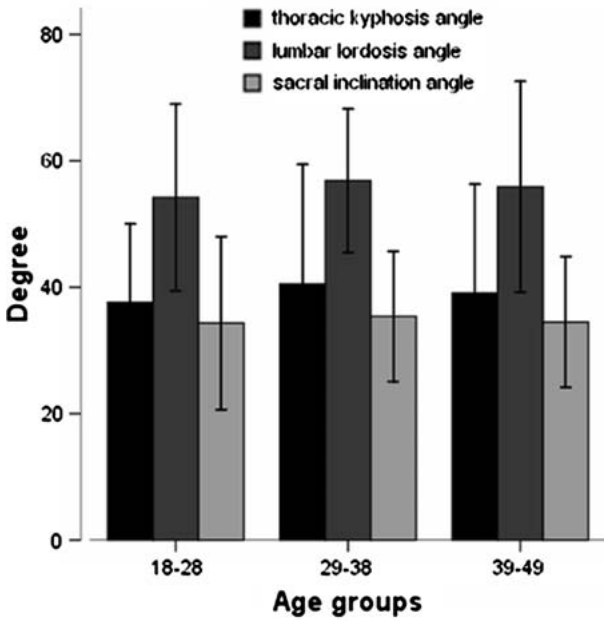

Fig. 4. The vertebral angles of the age groups. There is no significant difference between groups ($p > 0.05$, ANOVA) (T above the bar depicts standard deviation).

Discussion

Large breasts are generally associated with physical symptoms such as chronic neck, shoulder, and back pain, as well as stiff neck, painful brasserie strap grooving, and persistent intertrigo in the inframammary folds [1,3,4,7,8,12,14,15]. Before reduction mammoplasty, almost all patients try to deal with these problems by losing weight, using supportive bras, taking medications, and applying physical therapies. However, most of these measures cannot provide effective permanent relief of these annoying symptoms. Therefore, many women with large breasts ask for breast reduction surgery to relieve their health problems and to improve their physical and social activities. On the other hand, some women want to undergo a reduction mammoplasty procedure for cosmetic reasons alone.

Some studies have been published to prove that macromastia is not only a cosmetic problem, but also a physical and psychological health problem [1,3,4,7,8,12,14,15]. However, almost all these publications are questionnaire-based retrospective studies. In other words, all are based on the preoperative and postoperative subjective complaints of the patients who experienced reduction mammoplasties.

Only two studies have aimed to explain the mechanism of the back pain among large-breasted patients [9,10]. The anatomic and physiologic mechanisms of

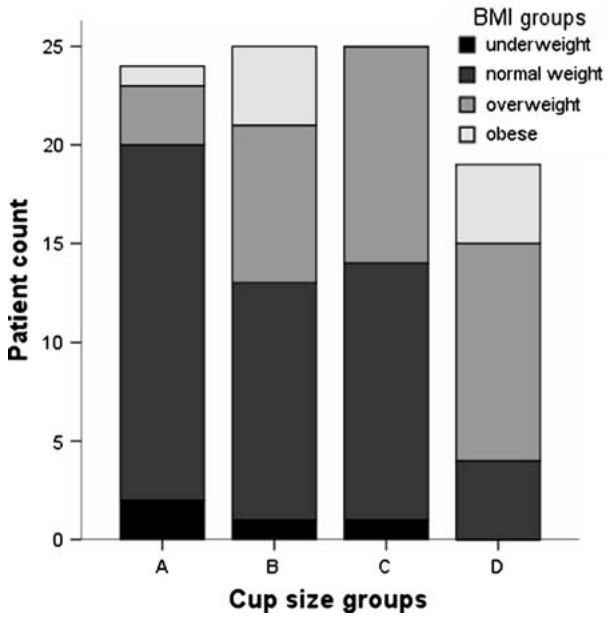

Fig. 5. The body mass index (BMI) distribution between the cup size groups. Group D had a significantly higher BMI ($p < 0.05$, ANOVA).

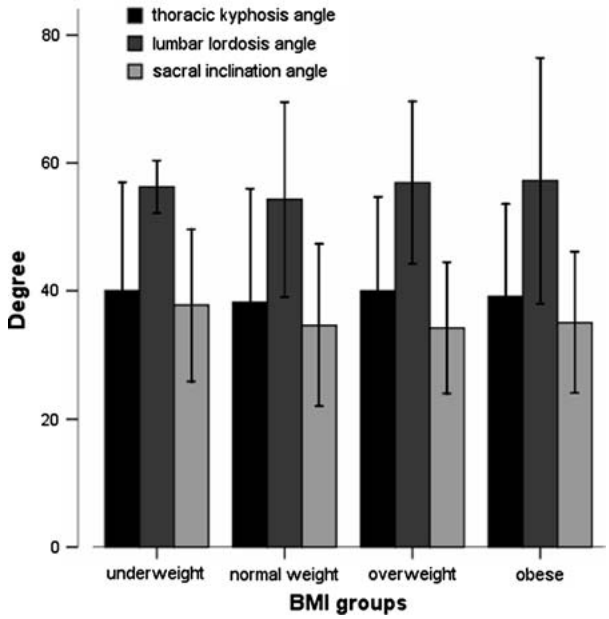

Fig. 6. The vertebral angles of the body mass index (BMI) size groups. There is no significant difference between groups ($p > 0.05$, ANOVA) (T above the bar depicts standart deviation).

physical symptoms associated with macromastia have been theoretically postulated by these studies. However, to our knowledge, there is not sufficient objective data about the effect of breast size on posture in the medical literature.

The current study confirms that breast size could be an important factor affecting body posture, especially the thoracic kyphosis and lumbar lordosis angles. We did not find any effect of breast size on the sacral inclination angle. However, positive correlation was detected between the lumbar lordosis and sacral inclination angles. It is well known that the vertebral column has a precise balance, and that a change in any part of it will be compensated by other regions. Large breasts seem to affect the thoracic and lumber part of the vertebral column. The affect of macromastia on the sacral part of the vertebral column could not be proven statistically in this study. Because age distribution was similar in all the study groups, age was not an important variable that affected our results.

Most women with larger breasts also have a higher BMI. Accordingly, the BMI rates were significantly higher in our D cup–sized group. Therefore, we expected a positive correlation between BMI and measured vertebral column angles. However, unexpectedly, we could not detect a statistically significant relationship between BMI and vertebral column angles.

This study had some limitations because all the vertebral angle measurements were shown to be distributed widely in the normal population [17]. Therefore, it is hard to determine the pathologic values for these angles clearly. On the other hand, this study gives important clues about the affect of breast size on the posture of the vertebral column, and confirms that women with larger breasts have different vertebral column angles.

A question arises in this situation: Which reduction mammoplasties should be covered by insurance companies? In some countries, insurance companies cover the expenses of reduction mammoplasties in which the resection weights exceed 350 g. However, in many countries this procedure is not covered by insurance companies. Because macromastia was shown to have a physical influence on the vertebral column, especially in D cup–sized patients, we believe that most reduction mammoplasties are not cosmetic procedures, and that the surgical expenses should be covered by insurance companies as for any other orthopedic surgery.

To eliminate the effect of osteoporosis, we did not include postmenopausal women in this study. However, it can be assumed that the effect of large breasts on an osteoporotic vertebral column might be even higher. Currently, an ongoing prospective clinical study is investigating the effect of macromastia on the vertebral column among osteoporotic women in our department. Another ongoing prospective clinical study seeks to determine whether any vertebral angle changes occur after reduction mammoplasties for D cup–sized patients.

Conclusion

Large breasts (D cup size or larger) have a statistically significant physical effect on the vertebral col-

umn and can alter the thoracic kyphosis and lumbar lordosis angles.

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