

# Effects of soft tissue stretching using negative pressure on women's breast augmentation

Kyung-Yun Kim<sup>1</sup>, Eun-Ju Lee<sup>2\*</sup>

<sup>1</sup>Professor, Department of Cosmetic Engineering, Konkook University

<sup>2</sup>Manager, Rin W

## 음압원리를 이용한 연부조직 스트레칭이 여성의 유방 확대에 미치는 영향

김경연<sup>1</sup>, 이은주<sup>2\*</sup>

<sup>1</sup>건국대학교 화장품공학과 교수, <sup>2</sup>린더블유 과장

**Abstract** There is a growing interest in breast augmentation surgery, which can most effectively maximize femininity, among modern women around the world. However, breast augmentation surgery is considered one of the most terrifying surgeries many women are afraid of, as many cases of its side effects have been reported. As a way to provide a complementary method to deal with it, this study investigated the effects of a non-surgical breast enhancement program by stretching soft tissue of the breast. According to the results, there was no change in body weight and breast elasticity, but there were marked increases in breast cup size, breast diameter and volume of the women who used this program. The external soft tissue expansion system was found to be effective in Korean women's change of breast shape. On the other hand, users should use this system regularly for some period of time, and this would limit their social activities. Therefore, for the effective use of this system, its users should make individual efforts.

**Key Words** : Negative pressure, Breast augmentation, Soft tissue, Non-surgical method, Stretching breasts.

**요 약** 오늘날 현대 여성들은 여성성을 가장 극대화할 수 있는 가슴 성형에 대한 여성들의 관심은 더욱 커지고 있다. 그러나 유방 확대술은 부작용에 대한 논란이 지속되고 있으며 많은 사람들이 두려워하고 있는 수술 중의 하나이다. 이러한 부분을 보완하고자 본 연구는 한국여성 23명을 대상으로 E사의 비수술적인 유방 확대 프로그램인 가슴 스트레칭 기기를 10주동안 사용하여 가슴이 형태적 변화를 연구하였다. 실험 결과로 체중의 변화는 없었으나 가슴의 컵 사이즈 확대, 유방 직경 증가, 유방 부피가 증가하였으며 가슴 탄력의 변화는 거의 없는 것으로 확인되었다. 가슴 외부 연부조직 확장 시스템이 동양인 한국 여성에게 가슴의 형태적 변화에 도움이 되는 것으로 확인되었다. 그러나 이 시스템은 일정 기간 사용 시간을 준수하기 위해 사회적인 생활에 제약을 받을 수 있으며 개인적인 노력이 뒷받침되어야 한다.

**주제어** : 음압원리, 유방 확대, 연부조직, 비수술적 방법, 유방 스트레칭.

\*Corresponding Author : Eun-Ju Lee(kiss1027@hanmail.net)

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## 1. Introduction

The women in the modern world have a growing desire to express themselves due to their increased social activity, a higher standard of living, and an increased tendency for spending. As such, the women have become extremely eager to invest in and take care of their appearance, and some would even artificially change their appearance if their appearance is not satisfying[1]. In the midst of this ever-changing standard of beauty according to the rapidly changing socio-cultural context, many women recognize the reality and influence of their own appearance and invest time, money, and physical and mental efforts to enhance their appearance to increase their competitiveness, and engaging in many activities to overcome any blemishes in their appearances[2]. Especially, the standard for body shape continuously changed throughout the era, and the methods to maintain the ideal body shape has changed accordingly. Currently, Korean society considers a slender body with robust breasts as the ideal body type[3,4]. As the interest in enhancing bodily appearance increased, the market for cosmetic plastic surgery to transform into the desired appearance is continuously growing[5,6]. However, many women are reluctant about deciding to undergo plastic surgery due to many factors including their reservation on the plastic surgery as well as their concern for side effects[7-9]. With the increasing interest and desire of women to have ideal breasts, the study investigated the effect of the external soft-tissue expansion system through the stretching of the external soft-tissue to propose a new method in natural breast augmentation without having to undergo a plastic surgery, which may cause several side effects. The mechanism for the growth involves a chain reaction of biochemical reactions induced by the stretching, which causes the cellular growth and tissue regeneration[10,11]. The cellular growth mechanism induced from the

stretching movement involves various types of growth factors, cytoskeletal structure, protein signaling enzymes and so forth, and these molecules create a variety of chain reaction networks. This complicated chemical network is being initiated by the signal transduction pathway induced by the stretching movement, and this elaborate series of reactions contribute to the cellular and tissue growth. However, the mechanical force and the duration of the force being applied must be appropriately balanced to prevent cell death while facilitating adequate cellular proliferation[11]. A clinical study conducted in the United States with Western women utilizing the underlying principle of soft tissue stretching for breast tissue growth showed breast size increase[12]. However, as there are differences in body shape, physical constitution, and skin condition between the Westerners and Asians, this study was conducted in consideration of such differences to see the effect of the same breast augmentation system for the Korean women.

## 2. Experiment materials and methods

### 2.1 Materials

The materials used in this study is an external soft tissue expansion system manufactured by a company named "E". This system consists of two dome-shaped apparatus to be worn on the breasts, microprocessor, an adjuster with sensor and breast pumps, a tube to connect the dome and the adjuster, and a support bra to hold the dome and adjuster in place when the user is engaging in outdoors activities. Fig. 1. Each dome is slightly bigger than the size of the breasts to be expanded, and the support bra upholds these two domes. Each dome has a silicone ring attached along with the silhouette of the breast, and allergy-free, adhering silicone gel is spread at the spots that directly come into contact with

the breast skin. This is to protect the skin from the vacuum suction apparatus. The sensor installed within the negative pressure adjuster is used for maintaining the vacuum pressure in the range of 15–25mmHg and is created to make a warning noise if the pressure is not being maintained within a certain range. Also, the saved data in the adjuster can be checked by connecting to a computer.



Fig. 1. Picture of the equipment's exterior

## 2.2 Methods

### 2.2.1 Study Design

This experiment was designed to observe the change in breasts when using a non-surgical method, a breast expansion system utilizing continuous negative pressure, as well as using the system along with a product to enhance breast elasticity. A total of 23 women who are interested in breast enhancement were chosen as the final study subjects; the study was conducted for 10 weeks.

### 2.2.2 Study subjects

#### A. Selection criteria

- Woman between the ages of 20 to 40  
Generally healthy woman
- A woman who has a BMI of between 20–24, within the normal weight range
- A woman who has breasts bigger than AA and A cup

#### B. Exclusion criteria

- A woman who is currently pregnant or being on a diet
- A woman who has a personal and/or family history of the breast-related disease
- Woman with chronic skin conditions (Chronic dermatitis, contact dermatitis, etc.)
- A woman who is currently undergoing hormone therapy, except birth control pills

#### C. Dropout criteria during the study

- The study is to be stopped if the participant has rapid weight change during the study ( $\pm 3$ kg).
- The participant is to be excluded from the study if the participant did not abide by the study protocol and schedule without a legitimate reason.

## 2.2.3 Measuring methods

#### A. Measuring device

The measuring devices used for the study are GL-310 height-weight scale that can automatically calculate BMI, a 7mm-width measuring tape, a skincare-grade plaster to create a breast model, and a measuring cylinder to measure the volume.

#### B. Breast circumference deviation

The bust circumference is a measurement that dictates the size of the women undergarments; the size of bra is determined by the underbust measurement and cup size, and the cup size is calculated by [breast circumference measurement – underbust measurement]. The cup measurements are defined as the following: AA cup if the difference is  $5 \pm 1.25$ cm, A cup if the difference is  $7.5 \pm 1.25$ cm, B cup if the difference is  $10 \pm 1.25$ cm, and C cup if the difference is  $12.5 \pm 1.25$ cm [13]. Therefore, the differences in bust circumference could be a criterion to see the changes in breast height.

### C. Breast diameter

The horizontal diameter of both left and right breasts is defined by measuring the length from the center of the breast to the outer side of each breast (where the bra wire is touching the breast), going through the nipples. The measurement, in centimeters, is conducted with a tape measure; this breast diameter can verify the expansion of the side breast volume.

### D. "Chest triangle" measurement

The size of a "Triangle" formed by connecting the center of the clavicle and the tip of each nipple was measured. Fig. 2. This measurement is to evaluate the elasticity of the breast after using the system, and it is estimated that the decrease of length between the center of clavicle and each nipple shows increased elasticity while the length of the triangle's base, the length between each nipple was estimated to show the decrease of breast width, which is indicative of the breast "push-up" effect.

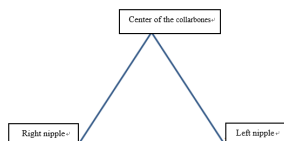


Fig. 2. Triangle zone in the chest to be measured

### E. Breast volume measurement

The area of each breast was measured by connecting these 4 spots: two spots marked when measuring breast diameter, a spot that is 10-cm away from the nipple to the direction of the clavicle, and a spot under the breast. A plaster model of the breast was created while the participant is standing shoulder-width apart. Then, the model was filled with water, then the amount of water was measured thrice using a measuring cylinder. The three measurements were averaged, and the volumes of the left and right breasts were calculated using the values. Fig. 3.



Fig. 3. Device for measuring the volume of breast

### 2.2.4 Statistical analysis

The statistical processing of the data collected from the study was performed using the SPSS statistics package program, and the data was analyzed using the following methods:

First, as for the measurement of breast circumference deviation, breast diameter, and "chest triangle", a parametric t-test was performed to obtain p-value, which was used for the evaluation of the statistical significance of the data.

Second, the paired t-test, which is used for comparing the average of two populations, was performed to verify the study result, and the p-value of less than 0.05 was deemed to be statistically significant.

## 3. Result

23 women initially participated in the study, and a total of 16 women completed the study. The seven participants that dropped out in the early phase of the study due to the difficulty of complying with the 10-hours use requirement as well as discomfort during the study. The remaining 16 participants used the system for an average of 10.2 hours per day for 10 weeks, and the system was mainly used during the sleeping hours at home as most of the participants were working professionals.

### 3.1 Weight changes

The average weight before the experiment was

58.8kg, whereas the average after the experiment was 58.4kg. Almost no change in body weight was observed. Table 1.

**Table 1. Changes in body weight**

Before (kg)	After (kg)	Comparison of group p-value*
58.8	58.4	0.354

### 3.2 Changes in upper and lower breast circumference difference

Since every participant used the same system, the overall change of the breast size before and after the study was observed. The average growth of breast size after 4 weeks was 1.72cm, and 2.34cm after 10 weeks. As mentioned earlier, since a "cup" size is 2.5cm, the result showed approximately a "cup" worth of growth, which is calculated as a 29% growth rate after the 10 weeks. Table 2.

**Table 2. Changes in the circumference of upper bust and under bust (unit: cm)**

Site	Week	N	Increment (%)	p-value <sup>1</sup>
circumference difference	0W	16	–	–
	4W	16	21.3 ▲	0.02
	10W	16	29.0 ▲	0.01

<sup>1</sup>Significantly different at \* $p < 0.05$  compared with before treatment.

### 3.3 Changes in breast diameter

The data for breast diameter measurement was computed by combining the data of experimental and control group, and the results showed a 2.84cm increase on the left breast and 3.04cm increase on the right breast ( $p = 0.0001$ ). Generally, most women have asymmetrical breasts, and our result showed that the participants showed greater growth on the right breast. Table 3. Also, breast diameter showed a similar tendency as the increase of difference between upper and lower breast circumference, and this generally uniform enhancement of the breast is thought to be

caused by the hemispherical shape of both the breast and the system.

**Table 3. Changes in breast diameter**

(unit: cm)						
Site	N	Mean	SD	SEM	t	p-value <sup>1</sup>
Left	16	2.84	1.7	0.4	-6.8	0.001
Right	16	3.04	2.5	0.6	-8.2	0.001

<sup>1</sup>Significantly different at \* $p < 0.05$  compared with before treatment.

### 3.4 Changes in the "breast triangle"

In terms of the changes in the "breast triangle", the left side was increased by 0.23cm, the right side was increased by 0.01cm, and the base was increased by 0.13cm. Table 4. The p-values for all three changes were greater than 0.05, showing no statistical significance. This may indicate that 10 weeks would be a short period to observe significant changes in breast elasticity compared with the size, and it can be extrapolated that long-term management would be necessary to enhance the elasticity of the breasts.

**Table 4. Changes in triangle zone of the chest**

(unit: cm)					
Site	0 week	4 week	10 week	Mean	p-value*
Center	20.03	20.14	20.27	-0.2	0.21
Right	19.62	19.64	19.63	-0.01	0.97
Left	18.93	19.11	19.06	-0.1	0.34

Significantly different at \* $p < 0.05$  compared with before treatment.

### 3.5 Changes in breast volume

The measurement of breast volume was done by creating a plaster model of the breast before and after the study, and the volume was measured using a measuring cylinder. The result was calculated using three randomly selected measurements and is shown on the table. The range of increase in the left and right breast volume ranged from 50 to 75mL. Table 5. Considering the volume changes observed in the three cases, it is expected that the other

remaining cases would show a similar change in breast volume.

**Table 5. Changes in breast volume**

N	Before		After		Volume increase	
	Left	Right	Left	Right	Left	Right
A	110	115	160	175	50	60
B	165	200	240	250	75	50
C	195	180	245	255	50	75

(unit :ml)

#### 4. Discussion

With the increasing interest in women's breast, the study investigated the effect of external soft-tissue expansion system to propose a new method in natural breast augmentation without having to undergo plastic surgery. Even though the study did not show a dramatic change in breast size compared with the surgical method, it showed relatively satisfying results including breast growth and shaping. A previous study conducted with Western women using a similar system[12] under the same condition (10-hour use for 10 weeks) showed an average of 125cc increase among 12 participants. Considering the 104cc increase is approximately equivalent to 2.5cm, the study showed an increase that is slightly greater than a cup. Considering Korean women generally have denser breast tissues and has a lower rate of fat synthesis compared with Western women, this study produced a better result[14]. In conjunction with this, the analysis of 16 participants shows that a more increase was shown if the initial breast volume and body fat contents indicated from the BMI were higher. Since most of the breast consists of fat, people with more initial breast volume and an appropriate amount of body fat would have better results when using the system as it facilitates the activity of fat.

#### 5. Conclusion

With the recent increase in women's social advance, the interest in beauty in general has increased greatly, and the perspective on beauty is also becoming more diverse. With these recent trends, many women desire to have beautiful bodies, and in particular, a beautifully shaped, bigger sized breasts. However, other than plastic surgeries that could cause side effects, there were no guaranteed methods to obtain the desired shape and size of the breast[15]. Therefore, this study was conducted to see whether the external soft tissue expansion, a safe and effective method, would be effective in enhancing Korean women's breast without having to worry about any side effects that may be caused by surgery. The results are shown below. First, while all participants(n=16) had no change in body weight, the difference between upper and lower breast circumference increased by 2.47cm, achieving a "cup" worth of breast enhancement. As  $p=0.001$ , the result was deemed to be statistically significant. Second, the breast diameter was measured to evaluate the changes in the side breast volume. The result of this measurement also showed an average of 2.84cm increase on the left breast and 3.04cm on the right breast. As  $p=0.001$ , the result was deemed to be statistically significant. Third, the changes in the "breast triangle" showed a 0.23cm increase of the left, 0.01cm on the right, and 0.13cm on the base. As the result showed a p-value greater than 0.05, thus the result was not statistically significant. Fourth, since the change in breast volume observed in three randomly selected participants showed a 50-75mL increase in the measurements using plaster models, other remaining participants are expected to have experienced similar volumetric increases. In conclusion, the external breast soft tissue expansion system helps Korean women to enhance breast size to some degree. Since the

system requires the user to dedicate a certain amount of time per day for an extended period, the user must put forth some effort as the requirement may cause restrictions on the user's social life. While this non-surgical breast soft tissue expansion does not guarantee a dramatic change as the surgical breast augmentation, the benefit of this method is that no side effects that may be caused by the surgery will be experienced. Therefore, this method would be suitable for an individual who is avoiding surgical breast augmentation with a relatively lower expectation of breast size change.

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김 경 연(Kyung-Yun Kim)

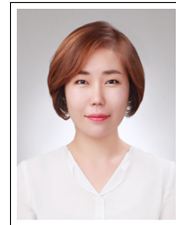
[정회원]



- 2011년 8월 : 건국대학교 향장학(석사)
- 2016년 2월 : 건국대학교 향장생물학 (이학박사)
- 2017년 5월 ~ 현재 : 건국대학교 화장품공학과 산학겸임 교수
- 관심분야 : 화장품, 피부과학
- E-Mail : skykkr00@nate.com

이 은 주(Eun-Ju Lee)

[정회원]



- 2009년 2월 : 서경대 피부예술학(학사)
- 2011년 8월 : 건국대 향장학(이학석사)
- 2007년 9월 ~ 현재 : 린더블유 화장품 기획과장
- 관심분야 : 향장, 대체의학
- E-Mail : kiss1027@hanmail.net