# Body posture in women after mastectomy and its changes as a result of rehabilitation

*Rostkowska E[1]*, Bąk M[2], Samborski W[3]*

[1] University School of Physical Education in Poznań, Clinic for Physiotherapy, Rheumatology and Rehabilitation, University of Medical Sciences, Poznań, Poland
[2] Higher Vocational State School in Leszno, Poland
[3] Clinic for Physiotherapy, Rheumatology and Rehabilitation, University of Medical Sciences, Poznań, Poland

## Abstract

**Purpose:** The aim of the study is: 1) to analyse selected features of body posture in women after mastectomy, 2) to compare them with body posture of healthy women, 3) to determine the effect of rehabilitation physical exercises on the changes in body posture in women after mastectomy.

**Material and methods:** The research material consisted of 85 women after mastectomy examined once, including 40 of them who were additionally examined twice at six-monthly intervals. Moreover, a group of 20 women was isolated who regularly attended rehabilitation classes for a period of one year in question. A comparative group was a group of 85 healthy women. The examinations were performed using photogrametric assessment of body posture.

**Results:** Distinct adverse changes in body posture of women after mastectomy in comparison with healthy women were found, manifested mainly in asymmetry of trunk and shoulder girdle and greater forward leaning of the trunk. Significant relationship was indicated between the operation of mastectomy and the asymmetry of position of scapulas.

**Conclusions:** When comparing the changes in the features of body posture in the group of women who exercised regularly with other women for the period of one year it was found that a positive effect of regular rehabilitation was keeping the angle of body inclination on the same level and improvement in trunk symmetry, position of scapulas and shoulder girdle.

**Key words:** mastectomy, posture, rehabilitation, exercise therapy.

* CORRESPONDING AUTHOR:
University School of Physical Education in Poznań
Clinic for Physiotherapy, Rheumatology and Rehabilitation
University of Medical Sciences
Droga Dębińska 10C, 61-555 Poznań, Poland
Tel: +48 61 8355423; +48 61 8228723
e-mail: jaroe8@wp.pl (Elżbieta Rostkowska)

Received 19.09.2005 Accepted 20.03.2006

## Introduction

Mastectomy is an operation which causes many changes in a woman's body. Its consequence are, among other things, lymphatic oedemas, limitation of movements and strength of the upper limb of the patient, experiences in the emotional sphere, difficulties related to the postoperative scar and the results of supplementing treatment such a radiotherapy or chemotherapy. Significant complications after mastectomy are changes in body posture caused both by disorders in body static as a result of amputation and limitation of movements and soreness of the spine.

The problem of changes in body posture, as a result of mastectomy is not well known. It seldom appears in scientific literature. It is, however, an important problem, both from the point of view of medical and psychological rehabilitation. Incorrect body posture may cause other somatic anomalies. For the patients good-looks related to body posture is the basis for better well-being [1,2].

Thus physicians, psychologists and patients consider mastectomy as both physical and psychological problem. Among physical impairments special attention is paid in the literature to limitations in the shoulder joint, suggesting exercise in water and swimming as effective therapy [3]. Also Reksidler [4] recommends exercises mainly in water as successful both psychic and physical therapy. On the other hand Hahn [5] suggests ski sport as effective form of therapy, bringing back self-satisfaction and diminishing depression after mastectomy.

Another argument for the physical activity recommended to women after mastectomy is based on the research conducted in women undergoing chemotherapy. In eight weeks after the surgery marching on an exercise track followed by the measurements of physiological parameters were performed. The results showed that even if the exercises caused fatigue on the same day in comparison to the days without exercise, there was no cumulative effect [6].

Lymphatic oedema and its consequences are also a problem in women who underwent mastectomy. As Schunemann et al.

*Table 1*. **Characteristics of the group of women after mastectomy (group A) on the first examination, the only one for this group**

| Characteristics of subjects (N=85) | $\overline{X}$ | min-max | SD | v (%) |
|---|---|---|---|---|
| Age of subjects (years) | 54.6 | 35-79 | 9.6 | 17.6 |
| Operation age (years) | 51.4 | 34-79 | 10.4 | 20.3 |
| Time from operation (years) | 3.4 | 0-14 | 4.02 | 117.5 |
| Weight (kg) | 68.9 | 49- 98 | 12.9 | 18.7 |
| Height (cm) | 161.6 | 150-176 | 5.6 | 3.5 |

*Table 2*. **Characteristics of the comparative group of healthy women (group B)**

| Characteristics of subjects (N=85) | $\overline{X}$ | min-max | SD | v (%) |
|---|---|---|---|---|
| Age of subjects (years) | 51.5 | 42-60 | 4.3 | 8.4 |
| Height (cm) | 164.4 | 150-178 | 5.9 | 3.6 |

showed in their study [7] among 5 868 women after mastectomy in 1 405 lymphatic oedema was observed (assessed by the increase of two centimeters of the operated limb's circumference). Physical activity is a part of antioedematous therapy.

According to many authors as Damm [8], Schulz et al. [9] and Munstedt et al. [10] motion and positive effect on the psychic should be stressed in the therapy of women after mastectomy, teaching them how to lead active and healthy lives.

A question of trunk asymmetry in the frontal plane in women after mastectomy was the concern of Dobosz et al. [11,12]. They found a frequent asymmetry relating mainly to the position of scapulas and shoulders. However, no author has ever analysed in detail the changes in body posture caused by mastectomy, in relation to the time which elapsed after the operation.

In Poland breast reconstruction is still performed rarely. Women usually obtain external breast prostheses in the form of special underwear. The aim of using this kind of supplement of the missing tissue is, among other things, compensation of changes in trunk static caused by mastectomy. Regular use of external prosthesis is very important for the effectiveness of this method of compensation for a missing breast. It was found that a regular use of external breast prosthesis involving also wearing it every night results in smaller changes in body posture [13].

Śliwiński [14] and Dobosz et al. [11] also paid attention to significant changes in body posture and the change in the function of spine in women after mastectomy.

However, the available literature does not offer en exhaustive comparative study of women after mastectomy and healthy women, with a large number of subjects and a comprehensive analysis of many features of body posture depending on the degree of involvement of the subject in rehabilitation. The authors have undertaken such a study.

**The aim of the study is:**

- the analysis of selected features of body posture in women after mastectomy,
- determining differences between body posture of women after mastectomy and the posture of healthy women at a similar age,
- determining the effects of rehabilitation physical exercises on body posture in women after mastectomy.

## Material and methods

The following basic groups of subjects were selected for the analysis:

- group A – 85 women after mastectomy (*Tab. 1*),
- group B – 85 healthy women (*Tab. 2*).

The groups of these sizes were examined once. Fourty women from group A were additionally examined twice at six-monthly intervals. In total they were examined three times; in this way group C was formed. Some of them, 20 to be exact, systematically attended rehabilitation classes. The remaining 20 took part in rehabilitation unsystematically or did not attend this type of classes at all.

Group C was divided into:

- group Ce – 20 women after mastectomy systematically taking part in rehabilitation exercises,
- group Cn – 20 women after mastectomy exercising irregularly or not exercising at all.

24 of them underwent a left-sided operation, 15 a right-sided one, and one underwent the operation on both sides.

The examinations were carried out using photogrametric assessment of body posture which is based on the use of Moire topography [12,15,16]. This method involves taking measurements on the basis of computer photography of a subject's body and the use of the phenomenon of moire pattern. Obtaining spatial image is possible thanks to the device "projecting" lines on the subject's back which fall at various angles and are distorted. The image is recorded and analysed by a computer programme. During the examinations the women were standing.

From numerous results of measurements and calculations (in frontal, sagittal and transverse planes) obtained as a result of photogrametric assessment of body posture the following were selected for the analysis:

in the frontal plane

– trunk inclination angle (TIA) from the perpendicular in degrees, that is an angle in frontal plane between the perpendicular and the straight line going through points $C_7 – S_1$,

– maximum deviation of the line of spinous processes from the perpendicular (UK) in mm,

– difference in distance of lower angles of scapulas from the spine (OL) in mm,

– difference in the height of lower angles of scapulas (UL) in degrees,

– inclination angle of the line of shoulders from the level (SLA) in degrees,

in transverse plane, in degrees

– difference in depth of lower angles of scapulas (UB) (assessment of twisting),

– pelvis twist angle (PTA),

in sagittal plane, in degrees

– trunk leaning angle (TLA), that is an angle between the perpendicular and the line $C_7 – S_1$ in the sagittal plane,

– $\alpha$ angle that is an angle of inclination from the perpendicular of lumbosacral spine,

– $\beta$ angle that is an angle of inclination from the perpendicular of thoracolumbar spine,

– $\gamma$ angle that is an angle of inclination from the perpendicular of upper thoracic section,

– $\delta$ angle that is the total of $\alpha$, $\beta$, and $\gamma$ angles.

Additionally, results of measurements and calculations of such features as pelvis inclination angle (PIA), thoracic kyphosis angle (TKA), lumbar lordosis angle (LLA) and the ratio of the depth of thoracic kyphosis to its length (TKR) were analysed.

The normality of the distribution of analysed features of body posture was examined. Both normal distributions of the examined features and distributions not in line with normal distribution were found. For this reason in statistical analysis nonparametric tests were used. In tables where results of examinations with a distribution non-compliant with a normal distribution were presented, apart from arithmetic mean also the median and quartiles were shown.

The relation of each of the examined features to basic parameters was examined such as a women's age at the time of examination, a woman's age at the time of operation, time which elapsed from the operation in years, side of amputation (left, right), regularity of rehabilitation, using external breast prosthesis at night, weight and height.

The percentages of results within the norm and with a slight and significant deviation from the norm were specified.

**Methodology of rehabilitation exercises**

Women in the Ce group were regularly (twice a week) attending rehabilitation classes in a gym. Motion activity lasted about 60 minutes. The programme of therapeutic rehabilitation included:

- increasing or maintaining mobility of shoulder joint on the operated side,
- increasing or maintaining muscle strength of the upper limb on the operated side,
- correction of faulty posture which arose as a result of amputation,
- balancing the strength of postural muscles and developing postural endurance,
- increasing the efficiency of respiratory system,
- prevention of lymph stasis in the limb and in the area of operation,
- improvement of physical efficiency and body fitness,
- effect on the mind in order to achieve adaptation to changed living conditions.

In the rehabilitation of the examined women after mastectomy exercises based on isotonic contraction and short isometric tension were mainly used. Apart from active exercises proper also active exercises without pressure (in suspension) were used, as long as functional abilities of the women allowed it. In individual cases (with weakened muscles, significant limitations of mobility, soreness in the shoulder girdle or other complications) passive or led exercises were used. In exercises low positions were mainly used, since physical exercises in high position (standing) are the greatest burden to the circulatory system, in particular its venous part. Low isolated positions force the subjects to perform proper movements, and do not allow compensating for a limited mobility of shoulder girdle with movement of neighbouring joints (for example using the spine).

Since in women after mastectomy the static and body symmetry are disturbed, scoliosis arises, kypholordosis is changed [11-14,17], it is important to locate the place where effects on the spine are exerted according to the steering rule. Control from above (of upper limbs) and from below (lower limbs) is used. In breathing exercises special attention is paid to breathing route – upper-costal, diaphragmatic and mixed) and to teaching correct breathing rhythm. The aim of breathing exercises is to improve pulmonary ventilation after the operation, gradual stretching of the scar and pressure on the cistern of chyle and abdominal part of thoracic duct (squeezing the lymph out of them towards the head).

During therapeutic rehabilitation educational effects were considered relating to the patient's behaviour at home, using antioedematous prophylaxis and making women realise the significance of physical activity in the prevention of secondary malignant disease.

## Results

**Trunk inclination angle** (**TIA**) informs about the inclination of the trunk to the left or to the right in the frontal plane. For 85 women after mastectomy it varied from 0.0 to 5.2 degrees ($\bar{X}$=1.53°, med=1.2°). For 67 of them the trunk was deviated to the left, for 17 to the right, for one it was vertical. In healthy women 66 left deviations, 13 right deviations and 6 cases of vertical position of the trunk were noted. The results of these examinations indicate clearly that in approximately 78% of women, both healthy and after mastectomy, the trunk is deviated to the left in the frontal plane.

Deviations of TIA from the perpendicular which do not exceed 1.5° were considered normal, those of 3° were considered as slightly deviated from the norm, and those greater than 3° as strongly deviating from the norm (*Tab. 3*).

For 85 women after mastectomy 60% of results were normal, 30.6% of results were slightly deviated from the norm and 9.4% of results were significantly deviated from the norm. Searching for a relation between TIA and basic parameters listed in the "Methods" section only a relation between the direction of TIA (trunk deviated to the left or right) and the age of the subject during operation was found. Women operated at an older age more frequently have their trunks deviated to the right: Spearman's R=0.30 where p=0.006. This is not, however, linked to the side of operation.

*Table 3*. **Size of TIA and its relation to normative values in healthy women and in women after mastectomy in three examinations (in degrees)**

| TIA Group | | 1st examination | | 2nd examination | | 3rd examination | |
|---|---|---|---|---|---|---|---|
| | B | Ce | Cn | Ce | Cn | Ce | Cn |
| $\overline{X}$ | 1.24 | 1.74 | 1.37 | 1.42 | 1.84 | 1.83 | 1.74 |
| min-max | 0-3.6 | 0.3-3.4 | 0.3-3.3 | 0-3.1 | 0-0.4 | 0-4.3 | 0.4-3.7 |
| SD | 0.84 | 1.00 | 0.96 | 0.94 | 1.19 | 1.24 | 1.12 |
| v (%) | 67.9 | 57.5 | 70.2 | 66.3 | 64.6 | 67.8 | 64.3 |
| | | | % of results | | | | |
| Normal | 63.5 | 55 | 50 | 50 | 60 | 45 | 50 |
| slight deviation | 32.9 | 40 | 45 | 30 | 30 | 35 | 25 |
| large deviation | 3.5 | 5 | 5 | 20 | 10 | 20 | 25 |

*Table 4*. **Value of UK and its relation to normative values in healthy women and in women after mastectomy in three examinations (mm)**

| UK Group | | 1st examination | | 2nd examination | | 3rd examination | |
|---|---|---|---|---|---|---|---|
| | B | Ce | Cn | Ce | Cn | Ce | Cn |
| $\overline{X}$ | 4.14 | 5.30 | 4.37 | 4.60 | 4.44 | 4.69 | 5.16 |
| min-max | 0-10.4 | 1.8-10.4 | 1.1-9.3 | 1.1-9.4 | 1.1-9.7 | 1.2-19.6 | 1.2-12.6 |
| SD | 2.1 | 2.7 | 2.1 | 2.5 | 2.4 | 3.9 | 3.2 |
| v [%] | 50.0 | 50.2 | 47.2 | 54.8 | 54.3 | 83.4 | 62.4 |
| | | | % of results | | | | |
| normal | 70.6 | 55 | 70 | 60 | 65 | 75 | 55 |
| slight deviation | 28.2 | 35 | 30 | 40 | 35 | 20 | 40 |
| large deviation | 1.2 | 10 | 0 | 0 | 0 | 5 | 5 |

40 women after mastectomy who were examined three times were characterised by a greater value of TIA, thus a spine more deviated to the side than healthy women. This adverse effect was intensified for women not exercising regularly (Cn group).

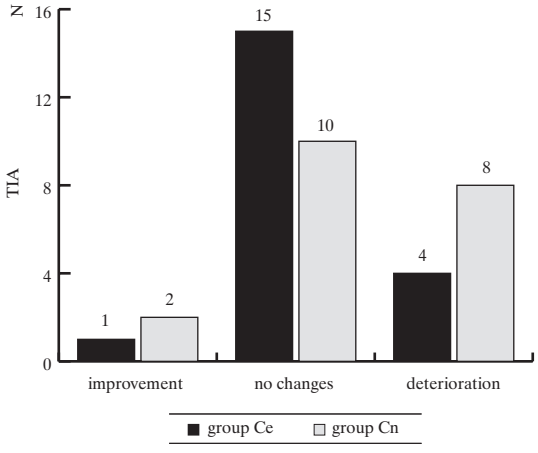
In the group of non-exercising women more cases of deterioration, that is increased TIA between the 1st and the 3rd examination, was found (*Fig. 1*).

**A maximum deviation of the line of spinous** processes from the perpendicular in the frontal plane **(UK)** informs about the existence of scoliosis even in case of compensating for it and ultimately vertical position of the spine. So there is a possibility of a high value of UK with TIA equal to zero.

In 85 women after mastectomy (group A) the arithmetic mean of UK was 5.0 mm (med 4.3, min-max: 1.1-12.1, $Q_1$-$Q_3$: 3.1-6.5), and in healthy women 4.1 mm (*Tab. 4*). The values of UK of up to 5 mm were considered as normal, those up to 10 mm as slightly deviated from the norm and those exceeding 10 mm as strongly deviated from the norm.

In group A 61.2% of UK were normal, 32.9% were slightly deviated and 5.9% strongly deviated. The value of UK did not differ in a statistically significant way between groups A and B. In group A value of UK was related to the use of an external breast prosthesis at night; the subjects who used them were characterised by a lower UK (Spearman's R=-0.23, p=0.030). The location of the spinous process most removed from the perpendicular on the length of the spine was related in group A only to the age of a woman at the time of the examination (R=0.281, p=0.0097). In women older at the time of the examination UK was more frequently located on lower parts of the spine (section $Th_7$ to $Th_{12}$ or lumbar vertebra), and in younger women on the section $Th_1$ to $Th_6$. Such regularity was not found in group B. In group A there were 52 UK results to the left and 33 to the right. Similarly in group B there were 50 UK to the left, 34 to the right and for one subject the spine was straight at the whole length. It can be said that similar to TIA though in smaller percentage, UK is more often directed to the left. No relation between the direction of UK and the side of operation was found.

*Figure 1*. **Changes in TIA between the 1st and the 3rd examination of women after mastectomy**




In women in Ce group a tendency to lowering of the UK was observed during exercises (*Tab. 4*) and in women in Cn group

*Figure 2*. **Number of subjects for whom improvement, deterioration or no change in UK was noted in three examinations (between the 1st and the 3rd examination)**

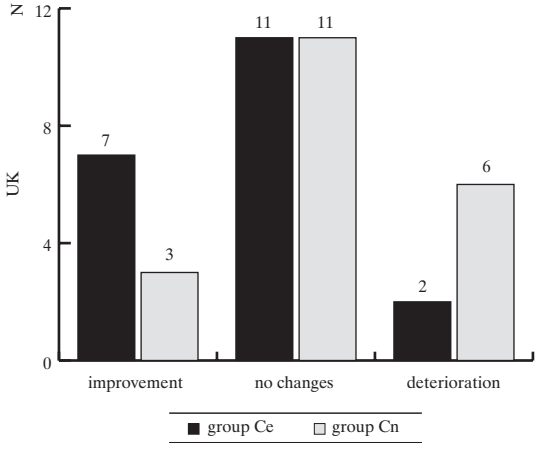



*Figure 3*. **Number of subjects in whom improvement, deterioration or no changes in OL were noted during three examinations (between the 1st and 3rd examination)**

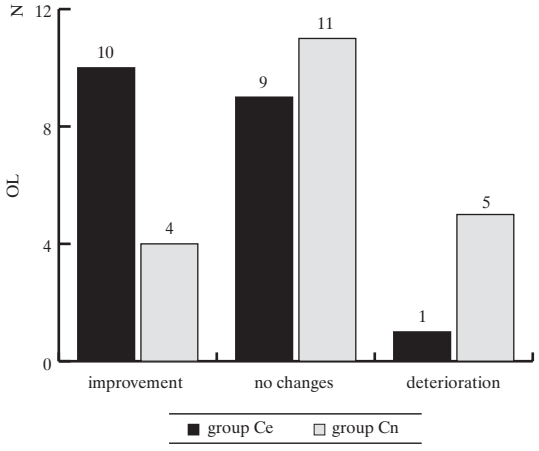



*Table 5*. **Value of OL and its relation to normative values in healthy women and in women after mastectomy in three examinations (mm)**

| OL Group | 1st examination | | | 2nd examination | | 3rd examination | |
|---|---|---|---|---|---|---|---|
| | B | Ce | Cn | Ce | Cn | Ce | Cn |
| $\bar{X}$ | 8.0 | 15.6 | 10.9 | 8.1 | 7.5 | 10.0 | 10.2 |
| min-max | 0.0-22.9 | 0-32.9 | 1.0-27.3 | 0-22.7 | 0-24.3 | 0.5-27.8 | 0.5-20.2 |
| SD | 5.5 | 9.1 | 7.2 | 6.8 | 6.4 | 7.4 | 5.2 |
| v (%) | 68.3 | 58.6 | 66.3 | 83.7 | 86.3 | 74.2 | 51.2 |
| | | | | % of results | | | |
| normal | 62.3 | 25 | 50 | 75 | 70 | 65 | 35 |
| slightly deviated | 34.1 | 45 | 40 | 15 | 25 | 25 | 60 |
| strongly deviated | 3.5 | 30 | 10 | 10 | 5 | 10 | 5 |

– the increase of the UK value. These changes were not always statistically significant.

In group Ce during rehabilitation exercises a number of subjects for whom improvement in UK increased, and the number of subjects for whom UK deteriorated, decreased. A reverse phenomenon was noted in group Cn (*Fig. 2*).

**The difference in distance between lower angles of scapulas** from the spine (**OL**) informs about the asymmetry of position of scapulas in relation to the spine. In group A it does not show normal distribution. It reaches the arithmetic mean of 11.7 mm (med=10.2 mm, min-max: 0.0-33.5, $Q_1$-$Q_3$: 5.1-17.6). The values of OL up to 10 mm were considered as normal, up to 20 mm as slightly exceeding the norm, and higher than 20 mm as strongly deviated from the norm. In the results of group A 48.2% of results were normal, 32.9% were slightly deviated and 18.8% were strongly deviated (*Fig. 3*).

OL does not display a relation with any basic features. It differs in a statistically significant way from group B to the disadvantage of group A (value of Mann-Whitney U test, U=2736 where p=0.0063). In 53 women after mastectomy the right scapula is further from the spine than the left one, in 2 both scapulas are at the same distance from the spine, and in 30 the left scapula is further from the spine than the right one. These numbers are similar in group B (50, 4, 31, respectively).

In group C the level of OL is varied depending on the research subgroup and time of examination (*Tab. 5*).

In group Ce during rehabilitation an improvement in OL was observed in half of all subjects. This result was not analysed statistically due to the small number of patients in groups Ce and Cn, but for the practice of the motional rehabilitation such improvement is highly important.

**The difference in the height of lower angles of scapulas** (**UL**) informs about asymmetry of scapulas in the frontal plane. In group A the distribution of results was not in line with normal distribution. The arithmetic mean was 2.9°, and the median 1.7° (min-max: 0.0-10.7, $Q_1$–$Q_3$: 0.9-4.2). Slight but statistically significant relation between the side of amputation and the direction of asymmetry of scapula position was found (Spearman's R=0.22, p=0.044). The scapula on the operated side is located higher. Mann-Whitney U test did not show a difference in UL between groups A and B. UL deviations and deviations of other discussed features that are SLA and UB, which did not exceed 1.5° were considered as normal, those of 3° were considered as a slightly deviated from the norm and larger than 3° as strongly deviated from the norm.

In group A 45.9% of normal results, 16.5% of results slightly deviated from the norm and 37.6% results with a strong deviation were found. Higher left angle of scapula was noted in 43

*Figure 4*. **Number of subjects for whom improvement, deterioration or no changes in UL were noted in three examinations (between the 1st and the 3rd examination)**

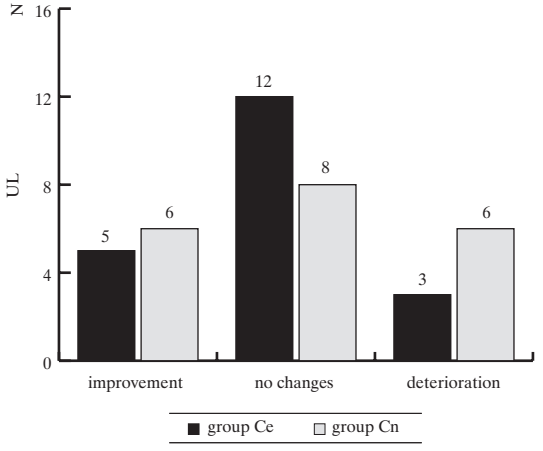



*Figure 5*. **Number of subjects in whom improvement, deterioration or no change in SLA was noted in three examinations (between the 1st and the 3rd examination)**

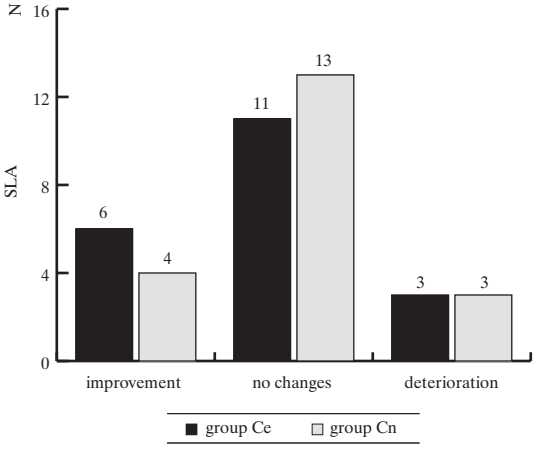



*Table 6*. **Value of UL and its relation to normative values in healthy women and in women after mastectomy in three examinations (degrees)**

| UL Group | | 1st examination | | 2nd examination | | 3rd examination | |
|---|---|---|---|---|---|---|---|
| | B | Ce | Cn | Ce | Cn | Ce | Cn |
| $\overline{X}$ | 1.91 | 2.03 | 2.61 | 2.26 | 2.55 | 1.92 | 2.52 |
| med | 1.2 | 1.65 | 1.2 | 2.15 | 1.8 | 1.45 | 1.8 |
| min-max | 0-6.6 | 0-6.5 | 0-10.7 | 0-7.1 | 0-7.3 | 0-5.2 | 0-7.7 |
| $Q_1$ | 0.9 | 0.8 | 0.4 | 0.8 | 1.4 | 0.95 | 0.9 |
| $Q_3$ | 3.1 | 3.6 | 4.3 | 2.95 | 3.05 | 5.2 | 3.25 |
| | | | | % of results | | | |
| normal | 55.3 | 45 | 55 | 40 | 25 | 55 | 35 |
| slightly deviated | 18.8 | 25 | 10 | 40 | 50 | 30 | 30 |
| strongly deviated | 25.9 | 30 | 35 | 20 | 25 | 15 | 35 |

*Table 7*. **Value of SLA and its relation to normative values in healthy women and women after mastectomy in three examinations (degrees)**

| SLA Group | | 1st examination | | 2nd examination | | 3rd examination | |
|---|---|---|---|---|---|---|---|
| | B | Ce | Cn | Ce | Cn | Ce | Cn |
| $\overline{X}$ | 0.91 | 1.52 | 1.41 | 1.33 | 1.29 | 1.22 | 1.42 |
| min-max | 0-3.7 | 0-3.0 | 0.4-5.1 | 0-2.7 | 0-4.5 | 0-3.5 | 0-5.7 |
| SD | 0.77 | 0.85 | 1.15 | 0.79 | 1.03 | 1.03 | 1.38 |
| v (%) | 84.7 | 56.0 | 81.5 | 59.4 | 79.8 | 84.4 | 97.3 |
| | | | | % of results | | | |
| normal | 82.4 | 45 | 70 | 55 | 60 | 70 | 70 |
| slightly deviated | 15.3 | 55 | 20 | 45 | 35 | 20 | 20 |
| strongly deviated | 2.4 | 0 | 10 | 0 | 5 | 10 | 10 |

women in group A and 35 women in group B. Higher right angle of scapula was found in 30 women after mastectomy and in 36 healthy women. Other women had both angles of scapulas at the same level.

In group Cn the value of UL was the least beneficial among all subjects (*Tab. 6*, *Fig. 4*).

**Shoulder line angle** (**SLA**) informs about deviations of the shoulder line from level in the frontal plane.

In group A it was characterised by a distribution not in line with Gauss' curve. The arithmetic mean of SLA in group A was 1.6° (med=1.3°, min-max 0-6.1, $Q_1$-$Q_3$ 0.8-2.1). The left shoulder was higher for 40 women after mastectomy and 30 healthy women. The right shoulder was higher for 41 women in group A and 43 women in group B. For other subjects the shoulders were level. In group A 58.8% of normal results, 32.9% of results with slight deviation and 8.2% of results with a strong deviation were found. Mann-Whitney U test indicated a significant difference between SLA values in groups A and B (U=2314, p=0.0000). No relations between the value and size of SLA and basic features were found.

Healthy women were characterised by a lower average SLA and a larger percentage of normal results or results with a slight

*Table 8*. **Value of PTA and its relation to normative values in healthy women and in women after mastectomy in three examinations (degrees)**

| PTA Group | 1st examination | | | 2nd examination | | 3rd examination | |
|---|---|---|---|---|---|---|---|
| | B | Ce | Cn | Ce | Cn | Ce | Cn |
| $\overline{X}$ | 2.69 | 3.9 | 3.2 | 4.1 | 3.3 | 5.4 | 3.8 |
| min-max | 0.0-15.2 | 0.0-21.5 | 0.0-7.1 | 0.0-16.7 | 0.0-9.1 | 0.0-16.3 | 0.0-17.2 |
| med | 2.2 | 3.1 | 3.4 | 3.3 | 2.7 | 4.4 | 2.1 |
| $Q_1$ | 0.8 | 1.2 | 1.3 | 1.5 | 1.0 | 2.7 | 1.2 |
| $Q_3$ | 3.9 | 4.6 | 4.8 | 5.0 | 4.5 | 6.4 | 5.2 |
| | | | % of results | | | | |
| normal | 68.2 | 50 | 50 | 45 | 55 | 25 | 60 |
| slightly deviated | 23.5 | 35 | 35 | 35 | 30 | 45 | 20 |
| strongly deviated | 8.2 | 15 | 15 | 20 | 15 | 30 | 20 |

deviation than women after mastectomy. The largest number of subjects with a significant deviation of SLA from the norm was in group C (*Tab. 7*, *Fig. 5*).

The difference in the value of SLA between healthy women and group Ce was statistically significant in the first examination (Mann-Whitney U test, U=490, p=0.003). In the next examinations it became insignificant, which would indicate the improvement of this feature as a result of rehabilitation.

However, the assessment based on of shifting women to another category in the period between the 1st and the 3rd examination did not display differences between groups Ce and Cn.

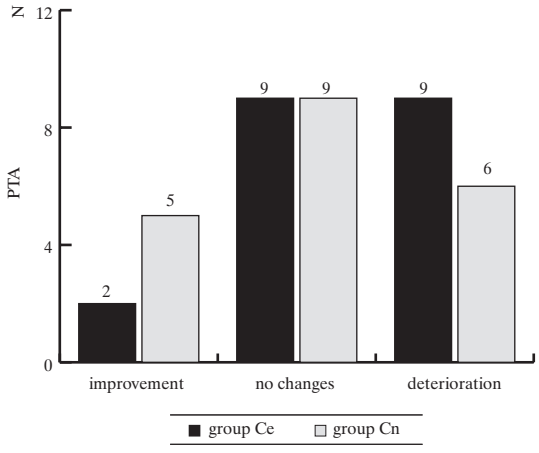
**The difference in the depth of lower angles of scapulas** informing about their twisting (**UB**) very significantly differs between groups A and B (Mann-Whitney U test, U=2555.5, p<0.001 where $\overline{X}$=3.7° in group A and $\overline{X}$= 2.3° in group B). However, in the group of women after mastectomy it does not show any relation to basic features. In 69 of them the left angle of scapula was more convex than the right one, in 14 the right one was more convex, and in 2 both scapulas were in the same position. Similar division of results was found in group B: 60, 18 and 7, respectively. The changeability of this feature in groups Ce and Cn did not indicate any statistically significant differences.

**Pelvis twisting angle** (**PTA**) informs about the difference in the depth of position of right and left posterior superior iliac spines, that is about their shift in relation to each other in the transverse plane.

In group A PTA had an average value of 3.9° and a similar value of the median of 3.7° (min-max 0.0-21.5, $Q_1$-$Q_{3\ 1.1}$-5.4). In 51 women in this group left posterior superior iliac spine was on a larger convexity than the right one, a reverse phenomenon was found in 28 subjects. In 6 women the pelvis was not twisted. In healthy women the same data amounted to: 48, 28 and 9, respectively, so they were very similar.

In group A the value of PTA does not correlate to any basic feature. However, the direction of PTA correlates to the operation age R=0.22, p=0.0399. In subjects operated at an older age the right side the pelvis is moved backwards. The value of PTA in women after mastectomy was higher than in healthy women (Mann-Whitney U test, U=2899, p=0.026). The results of measurements of PTA and the TLA discussed below, which do not exceed 3° were considered as normal, those up to 6° were considered as slightly deviated from the norm, and those exceeding 6° as strongly deviated from the norm. In group A 45.9% of results within the norm, 34.1% results with a slight deviation and 20% with a strong deviation from the norm were found. This is a much worse result than for healthy women (*Tab. 8*, *Fig. 6*).

*Figure 6*. **Number of subjects for whom improvement, deterioration or no changes in PTA were noted in three examinations (between the 1st and 3rd examination)**




**Trunk leaning angle** (**TLA**) informs about the leaning of the body forward or backward in the sagittal plane. If points $C_7$ and $S_1$ are situated on the same vertical line, TLA equals zero. In groups A and B distribution of results of TLA was in line with normal distribution. In group A TLA was related to body weight and height; taller and heavier women were more leaning forward (correlation coefficient R=-0.33 for weight and R=-0.28 for height with p<0.05). In group B it was related to height: taller women were more leaning forward (R=-0.30, p<0.05).

The comparison of groups A and B with a Student's test for independent samples indicated variation (t=2.8 where p=0.005). Women after mastectomy were more leaning forward ($\overline{X}$=-1.08°, SD=3.1°) than healthy women ($\overline{X}$=0.31°, SD=3.3°). In absolute numbers there were more subjects leaning forward among them.

*Table 9*. **Value of TLA and its relation to normative values in healthy women and in women after mastectomy in three examinations (degrees)**

| TLA Group | 1st examination | | | 2nd examination | | 3rd examination | |
|---|---|---|---|---|---|---|---|
| | B | Ce | Cn | Ce | Cn | Ce | Cn |
| $\overline{X}$ | 2.7 | 2.2 | 3.0 | 2.3 | 2.5 | 3.2 | 3.0 |
| min-max | 0.0-7.1 | 0.2-4.5 | 0.0-6.2 | 0.0-6.7 | 0.4-6.1 | 0.3-5.7 | 0.0-10.2 |
| SD | 1.8 | 1.2 | 2.0 | 1.8 | 1.8 | 1.6 | 2.8 |
| v (%) | 65.7 | 53.8 | 68.7 | 76.7 | 73.0 | 49.9 | 94.1 |
| | | | % of results | | | | |
| normal | 63.5 | 80 | 60 | 65 | 60 | 50 | 65 |
| slightly deviated | 30.6 | 20 | 25 | 30 | 35 | 50 | 25 |
| strongly deviated | 5.9 | 0 | 15 | 5 | 5 | 0 | 10 |

*Table 10*. **Value of α angle in healthy women and women after mastectomy in three examinations**

| α angle Group | 1st examination | | | 2nd examination | | 3rd examination | |
|---|---|---|---|---|---|---|---|
| | B | Ce | Cn | Ce | Cn | Ce | Cn |
| $\overline{X}$ | 6.1 | 6.9 | 8.2 | 7.6 | 6.4 | 9.4 | 7.2 |
| min-max | 0.0-18.1 | 0.0-24.5 | 0.0-16.3 | 0.0-14.9 | 0.0-14.2 | 0.0-19.6 | 0.0-20.5 |
| med | 5.3 | 5.8 | 8.5 | 7.0 | 6.2 | 10.3 | 7.8 |
| $Q_1$ | 2.8 | 3.1 | 3.3 | 4.6 | 3.2 | 7.1 | 3.1 |
| $Q_3$ | 8.9 | 9.7 | 12.2 | 12.0 | 9.5 | 13.0 | 8.8 |

Accepting as the most correct posture the situation when points $C_7$ and $S_1$ are in one vertical line, the number of normal results and results beyond the norm was established. Forward or backward deviation from the perpendicular up to 3° was considered as within norm, up to 6° as slight deviation and above 6° as strong deviation from the norm.

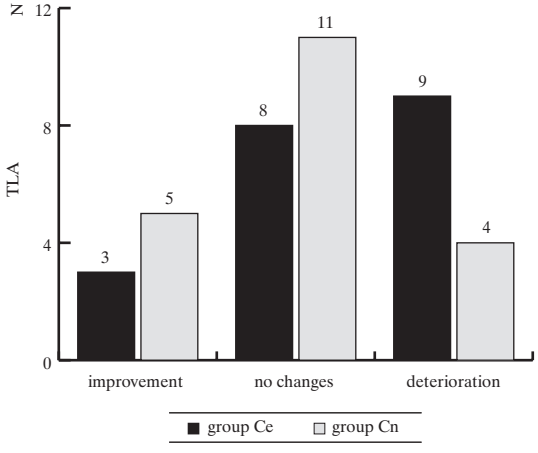
In group A 58.8% of results were normal, 37.6% of results displayed a slight deviation and 3.5% of results – a strong deviation from the norm. In group B there were more results within the norm (*Tab. 9*, *Fig. 7*).

Examining the relation between the time which elapsed from the mastectomy and the direction of TLA (leaning backward or forward) indicates that a recent operation is related to inclination forward and an operation long time ago to backward leaning.

When observing the direction of changes in TLA in group C (leaning forward or backward as a result of regular rehabilitation) ANOVA Friedman's test and Kendall's compatibility coefficient were used. In group Ce slight but statistically significant differentiation of this feature was noted in three examinations; the arithmetic means increased gradually, that is the subjects (group Ce) leaned forward more and more with each examination (Chi squared ANOVA=6.6, $p<0.038$). Women in group Cn leaned forward more and more as well, but it was not statistically significant.

The value of TLA is affected by proportions between α, β and γ angles. Therefore, the values of individual angles and their total value, that is δ angle were analysed. In group A an average value of α angle was 7.5° (with min-max 0.0-24.5° and SD=5.2°). In women after mastectomy α angle was characterised by a significantly greater changeability than in healthy women (*Tab. 10*). However, Mann-Whitney U test did not display statistically significant differences between distributions of results

*Figure 7*. **Number of subjects in whom improvement, deterioration or no change in TLA was noted in three examinations (between the 1st and the 3rd examination)**




of measurement of α angle between groups A and B. The values of α angle do not show a relation to any of the basic features. In group Ce α angle showed a similar value between the 1st and the 3rd examination, in group Cn it was decreasing distinctly, however, this difference tested with ANOVA-Friedman test is statistically insignificant.

The values of α, β, γ and δ angles were not assessed in terms of their compliance with normative values which in this case are very difficult to determine (*Tab. 11, 12, 13*).

In all groups β angle was characterised by normal distribution, in group A was on average 9.0° (SD=3.8, min-max 0.0-17.4). Thus, it did not differ significantly from the group of

*Table 11.* **Value of β angle in healthy women and in women after mastectomy in three examinations**

| β angle | | 1st examination | | 2nd examination | | 3rd examination | |
|---|---|---|---|---|---|---|---|
| Group | B | Ce | Cn | Ce | Cn | Ce | Cn |
| $\overline{X}$ | 9.7 | 10.3 | 10.0 | 9.0 | 10.8 | 7.9 | 9.9 |
| min-max | 1.8-17.5 | 5.3-15.1 | 3.3-17.4 | 2.0-16.5 | 3.4-17.0 | 0.6-12.1 | -0.4-16.7 |
| SD | 3.5 | 2.7 | 3.5 | 3.5 | 3.7 | 3.0 | 4.9 |
| v (%) | 35.1 | 25.8 | 34.6 | 38.6 | 34.6 | 37.9 | 49.5 |

*Table 12.* **Value of γ angle in healthy women and in women after mastectomy in three examinations**

| γ angle | | 1st examination | | 2nd examination | | 3rd examination | |
|---|---|---|---|---|---|---|---|
| Group | B | Ce | Cn | Ce | Cn | Ce | Cn |
| $\overline{X}$ | 15.8 | 16.4 | 17.5 | 19.6 | 17.6 | 19.9 | 17.7 |
| min-max | 2.2-30.8 | 10.3-24.5 | 4.1-29.1 | 8.6-29.3 | 6.6-24.2 | 8.2-27.4 | 9.1-30.1 |
| SD | 5.3 | 4.3 | 5.2 | 4.9 | 4.1 | 5.4 | 5.5 |
| v (%) | 33.4 | 26.3 | 29.5 | 25.0 | 23.3 | 27.3 | 30.8 |

*Table 13.* **Value of δ angle in healthy women and in women after mastectomy in three examinations**

| δ angle | | 1st examination | | 2nd examination | | 3rd examination | |
|---|---|---|---|---|---|---|---|
| Group | B | Ce | Cn | Ce | Cn | Ce | Cn |
| $\overline{X}$ | 31.6 | 33.5 | 35.7 | 36.1 | 34.8 | 37.2 | 35.0 |
| min-max | 17.2-49.8 | 24.7-57.1 | 22.6-52.0 | 24.5-51.2 | 25.2-41.4 | 19.0-55.7 | 20.4-45.2 |
| SD | 6.9 | 7.4 | 6.6 | 7.4 | 4.3 | 9.4 | 6.6 |
| v (%) | 21.9 | 22.0 | 18.4 | 20.5 | 12.5 | 25.3 | 18.8 |

healthy women. In group A its value was related to height in reverse relation (Spearman's R=-0.35, p=0.001). A similar relation was noted in group B (R=-0.33, p=0.0024). In group Ce its value was systematically going down, and these changes are statistically significant (ANOVA Friedman's $\chi^2$=8.3 p<0.016). This significance resulted mainly from the difference between the 1st and the 3rd examination.

The value of γ angle the results of which were also characterised by normal distribution, differed statistically significantly between women after mastectomy and healthy women (Mann-Whitney U test, U=2749, p=0.007). In group A its average value amounted to 18.1° (min-max 4.1-41.5, SD=5.4), it was not related, however, to any of the basic features. The value of this angle increased systematically in subsequent examinations in group Ce (ANOVA Friedman's $\chi^2$=7.7, p<0.02), in group Cn it was stable.

The δ angle is a total of α, β and γ angles. In group A δ angle reached an average value of 34° (min-max 20.6-57.1, SD=7.1). A total value of angles of spinal curvatures in women after mastectomy was higher compared to healthy women (Mann-Whitney U test, U=2939, p<0.036). The value of δ angle was in group A directly proportional to weight (Spearman's R=0.26, p=0.017). In group B no such relation was noted. In group Ce a total value of spinal curvatures was systematically growing, though in a statistically insignificant manner, and in group Cn it remained stable.

From additionally analysed features – pelvis inclination angle, thoracic kyphosis angle, lumbar lordosis angle and **the ratio of the depth of thoracic kyphosis to its length**, the latter one named as **TKR** showed some interesting properties. The values of TKR differed in a statistically significant way between groups A and B (group A $\overline{X}$=0.03, SD=0.016, group B $\overline{X}$=0.05, SD=0.012, Student's t -2.53, p<0.012). The lengths of thoracic kyphosis expressed as a percentage of the whole length of the spine are very similar in groups A and B. Thus, a lower average TKR in women after mastectomy is caused by a smaller depth of thoracic kyphosis in them ($\overline{X}$=7.8 mm) compared to healthy women ($\overline{X}$=11.6 mm). Regular participation in rehabilitation classes (group Ce) resulted in decrease (flattening) of thoracic kyphosis in a statistically significant way (arithmetic mean of TKR decreased in subsequent examinations 0.04, 0.02, -0.24, ANOVA Friedman's $\chi^2$=8.9, p<0.011). The results of the examinations allowed noting that in group Ce the length of lordosis in subsequent examinations increased, which resulted in shortening of thoracic kyphosis. Although statistically not significant, this change could be observed in group Ce, it did not occur in group Cn, though. The value of TKR correlated to a woman's age at the time of operation (R=-0.22, p<0.05).

## Discussion

The results of studies presented here make it possible to specify the features of body posture in women after mastectomy and compare them to the body posture of healthy women, which was the aim of the work. It can be stated that the body posture of women after mastectomy compared to healthy women is characterised by the following, statistically significant alterations:

– greater trunk inclination angle,
– greater symmetry of scapula position,
– higher position in the frontal plane of the scapula on the operated side,
– much greater angle of shoulder line which means that shoulder are more deviated from the level in frontal plane,
– much greater difference in the depth of lower scapula angles,
– greater angle of pelvis twisting,
– greater forward leaning of the trunk,
– greater total value of angles of spinal curvatures,
– lower ration of the depth of thoracic kyphosis to its length and lower depth of thoracic kyphosis. Thus, greater forward leaning of trunk in women after mastectomy is caused by a greater $\alpha$ angle in them,
– directly proportional relation between the value of $\delta$ angle and weight,
– a tendency to increase of the $\gamma$ angle and large interpersonal changeability of the $\alpha$ angle.

These results are in agreement with the results of few papers published up to date and concerning this topic [5]. However, the presented results of the trunk leaning angle (TLA) measurements differ in this article from what Dobosz et al. [6] presented in the paper presenting body posture of women after mastectomy. Like us, other authors, have not found any link between side of surgery and the direction of asymmetry of body posture alterations.

The relation between the results of examinations of body posture and features called basic were not strong and did not allow isolating one feature determining the body posture of women after mastectomy. However, it was found statistically significant that:

– there is a slight, although statistically significant relation between the side of amputation and the direction of asymmetry of position of scapulas; the scapula in the operated side is higher,
– women operated at an older age more frequently have their trunks deviated to the right, and the right side of their pelvises is moved backwards,
– the location of the spinous process furthest deviated from the perpendicular on the length of the spine was related in group A with the age of a women at the time of the examination. In women older at the time of examination UK most frequently was located on lower sections of the spine (section $Th_7$ to $Th_{12}$ or lumbar vertebra), and in younger women on section $Th_1$ do $Th_6$,
– recent operation is related to forward leaning of the trunk, and operation a long time ago with backward leaning of the trunk; it should be assumed that leaning of the trunk forward a short time after the operation is an analgesic and protective position which passes with time,
– the value of UK in group A was related to the use of external breast prosthesis at night; the subjects who used it were characterised by a lower UK.

The comparison of the changes in features of body posture in groups Ce and Cn allows us to note the following positive effects of rehabilitation in subjects who exercise regularly:

– maintaining TIA on a stable level,
– decrease that is improvement in UK, OL, SLA.

PTA is a feature which does not show improvement or even shows deterioration in women after mastectomy who exercise regularly. Since features related to the position of scapulas and shoulder girdle improved during exercises it may be assumed that this took place at a cost of compensation achieved by a change in the position of pelvis. This opinion should be, however, supported by a study of individual cases.

The increase in PTA in Ce group seems to be a negative effect of rehabilitation. If compensation is a result of anti-scoliosis exercises, more careful stabilisation of pelvis during all exercises affecting the spine, scapulas and shoulder girdle is needed. Their position should not be corrected at the costs of compensation by twisting the pelvis. Thus, emphasis should be placed on isolated positions during physical exercises.

It should be stressed that the groups Ce and Cn were not numerous, which negatively affected the statistical significance. And yet the results obtained three times when women from the group Ce exercised regularly are of great value for the practice of motional therapy.

The results of the examinations informing about the changes in spine angles ($\alpha$, $\beta$, $\gamma$ and $\delta$) and its natural curvatures (lordosis, kyphosis) are ambiguous. Women in group Ce during a year of exercises leaned forward more than group Cn where smaller leaning was also noted. In any case this is not a positive phenomenon. Thus, more exercises of back muscles – the thoracic part (decreasing the $\gamma$ angle) and exercises stretching the chest should be introduced to rehabilitation.

## Conclusions

In the study great changes in body posture of women after mastectomy were noted compared to healthy women at similar age. This phenomenon was so far only partly recognized [20]; however, it was not described in detail. It should be considered in what way the negative effects of mastectomy could be reduced. Hawro et al. [9] write about the significance of early, postoperation rehabilitation for the reduction of effects of mastectomy. The results of the studies are an argument for putting an emphasis on early, and then on long-term, continuous rehabilitation. This may be a way to stop later irregularities. Starting rehabilitation too late can lead to changes which are difficult to reverse.

Great changes in body posture are also an argument for wider introduction of breast reconstruction operations in Poland, since the use of breast implants gives better results in maintaining body symmetry [14]. Though asymmetry may also take place with the use of implant [14], its intensity is much smaller.

Lymphatic oedema also contributes to the intensification of disorders in body posture [3]. Rehabilitation should always be combined with antioedematous prophylaxis.

Undoubtedly taking part in rehabilitation, apart from its influence on somatic features of the subjects, has a very significant positive effect on their minds [2]. This is an additional important argument for popularization of rehabilitation in women after mastectomy.

Future research on the motional rehabilitation of women after mastectomy should head in two directions. First, the alterations in body posture should be monitored during regular physical exercises. There is an urgent need to work out an exact program of those exercises that improve particularly difficult features in the body posture. Patients should also be protected against compensatory changes. Another research topic is based on observation of alterations in body posture and their prevention in those women on whom new surgical techniques, e.g. breast reconstruction, were conducted.

**References**

1. Fries A, Reinhard G. The impact of mastectomy on dimensions of psychological and psychosocial experience and behaviour in affected women. Rehabilitation, 1996; 35(1), 54-64.
2. Moyer A, Salovey P. Predictors of social support and psychological distress in women with breast cancer. J Health Psychol, 1999; 4/2: 177-91.
3. Schuele K. Schwimmen mit Krebspatienten. Gesund durch Schwimmen, 1998; 151-5.
4. Reksidler B. Bewegungstherapie bei Albatio Mamme. Psychoterapie, 1990, 8, 384-387.
5. Hahn J. Erfahrungen aus dem Sport in der Krebsnachsorge am Beispiel der Skilaufens mit Mammakarzinompatientinnen. Gesundheitssport u. Sporther, 1994; 2/3: 14-5.
6. Schwartz A, Mori M, Gao R, Nail L, King M. Exercise reduces daily fatigue in women with breast cancer receiving chemotherapy. Med Sci Sports Exerc, 2001; 33(5): 718-23.
7. Schunemann H, Willich N. Lymphedema after breast carcinoma. A study of 5868 cases. Deutsche Medizinsche Wochenschrift, 1997; 122(17): 536-41.
8. Damm F. Sport als Veberlebenshilfe. Spiel und Sport in der Brustkrebsnachsorge. Fit und gesund im Sport. Frauen in Bewegung, 1996; 250-4.
9. Schulz T, Loetzzerich H, Peters C, Niemeier B, Schuele K, Uhlenbruck G, Michna H. Der Einfluss moderaten Ausdauertrainings in der Rehabilitation von Brustkrebspatientinnen. Ortop Tech, 1999; 50(4), 313-8.
10. Munstedt K, Milch W, Reimer C. Epicutaneous breast forms after mastectomy. Geburtshilfe und Frauenheilkunde, 1996; 65(1): 8-12.
11. Dobosz J, Malicka I, Woźniewski M, Skolimowski T, Barczyk K, Skolimowska B. Asymetria postawy ciała i czynność kręgosłupa u kobiet po mastektomii. Asymmetry of body posture and function of spine in women post radical mastectomy. Fizjoterapia, 1998; 6(3): 36-9.
12. Dobosz J, Woźniewski M, Malicka I. Ocena stopnia asymetrii tułowia w płaszczyźnie czołowej u kobiet operowanych z powodu raka sutka. Estimation of asymmetry in frontal plane in women post surgical treatment due to breast cancer. Fizjoterapia, 1999; 7(1), 52-6.
13. Bąk M, Rostkowska E. Wpływ stosowania protezy piersi podczas snu na postawę ciała u kobiet po mastektomii. The influence of using breast prosthesis during the night on the changes of body posture among women after mastectomy. (In Polish, English summary) Fizjoterapia, 2000; 8, 4: 11-5.
14. Śliwiński Z. Ocena dysfunkcji ruchowych kręgosłupa u kobiet po amputacji piersi. Assessment motor dysfunction of spine in women with mastectomy. Fizjoterapia, 1996; 4(3): 29-33.
15. Nowotny J, Zawieska D, Saulicz E. Fototopografia z wykorzystaniem rastra optycznego i komputera jako sposób oceny postawy ciała. Photography in which optical half-tone screen and computer are used as a means of assessing the body posture. Postępy rehabilitacji, 1992; VI(1): 15-23.
16. Patorski K, Rafałowski M, Kujawińska M, Zawieska D, Nowotny J. Computer aided postural deformity studies using moire and grid projection method. SPIE International Conference – Interferometry' 94, 1994, Warszawa, 16-22.05.1994, Abstracts, 93.
17. Cornish BH, Bunce IB, Ward LC, Jones LC, Thomas BJ. Bioelectrical impedance for monitoring the efficacy of lymphoedema treatment programmes. Breast Cancer Research and Treatment, 1996; 38(2): 169-76.
18. Svahn JK, Vastine VL, Landon BL, Dobke MK. Outcome of mammary prostheses explantation: A patient perspective. Annals of Plastic Surgery, 1996; 36(6): 594-600.
19. Hawro R, Bębenek M, Pudełko M. Wczesna pooperacyjna fizjoterapia po doszczętnym leczeniu raka gruczołu piersiowego. An early postoperative physiotherapy following mastectomy. Fizjoterapia, 1999; 7 (Suppl. 1), 12-7.
20. Raso DS, Greene WB, Metcalf JS. Synovial metaplasia of a periprosthetic breast capsule. Arch Pathol Lab Med, 1994; 118(3), 249-51.
21. Courney KS, Friedenreich CM. Relationship between exercise during treatment and current quality of life among survivors of breast cancer. J Psychosoc-Oncol, 1997; 15(3-4): 35-57.